THE

ELECTRICAL REVIEW.

VOL. LVI. JUNE 9, 1905. No. 1,437.

ELECTRICAL REVIEW.

Vol. LVI.] CONTENTS: June 9, 1905. [No. 1,437.

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MUNICIPAL ELECTRICAL TRADING.

"A DEFEAT which, if not reversed by the House of Lords, will be more ruinous in its effect on the electrical contracting trade than any war or other extraneous cause can ever be."

So says the editor of the *Electrical Contractor*, in referring to the passing of the Electrical Clauses of the L.C.C. (General Powers) Bill through the Committee stage of the House of Commons.

And what are these clauses? They read as follows:—

"To empower the Councils of the Metropolitan Boroughs being authorised to supply and supplying electricity to provide, sell, let for hire, fix, set up, alter, repair and remove wires, lamps, motors, meters and all manner of electrical machinery and apparatus, and to expend money upon the wiring and fitting and supplying with wires, fittings, machinery and apparatus the premises of any of their consumers, or prospective consumers, of electrical energy, and to enter into and carry into effect agreements and arrangements with respect thereto, and to make such charges therefor, whether directly or otherwise, as they may think fit."

"To empower the Councils of the Metropolitan Boroughs, or any of them, to borrow in the same manner, and subject to the same conditions as if such expenditure were for the purposes of the Electric Lighting Acts, 1882 and 1888, as amended by any subsequent Act, and upon such terms and conditions as to repayment and otherwise as may be specified in the Bill such sums of money as may be required by such Councils for the purposes hereinbefore mentioned."

There appears to have been a sort of half-hearted opposition to the Bill on the part of electrical contractors, who will have only themselves to blame when they find, later on, that, owing to rate-aided competition, they have to "shut up shop." It is all very well for the Committee to add a clause to the effect that any loss incurred in connection with the work shall not fall on the ratepayers; but someone must bear the loss, and in the long run it is the ratepayer.

It is monstrous that a business firm should be called upon to bear part of the cost of what is really a competing business.

We have received a good many letters from London contractors, expressing in the strongest terms their opposition to the Council's proposal. But why did not the contractors support the Electrical Contractors' Association in opposing the clauses when they had an opportunity of doing so? Surely they have had many object lessons as to the disastrous results which are likely to follow such apathy.

The Woolwich Bill went through practically unopposed, and it was the precedent of Woolwich which, coupled with the feeble opposition of electrical contractors, was the determining factor in the clauses going through the Committee stage.

And what has happened at Woolwich? Before the Woolwich authorities undertook electrical wiring, there were two electrical contracting firms there. Where are they now? As contractors they have both disappeared, crushed out of existence by municipal competition; by the competition of a municipality which they, as ratepayers, did their share to support.

One of the late principals is, we now learn, working as a journeyman employed by the Corporation in wiring one of its buildings.

This, then, is the prospect which opens up in every metropolitan borough, once this Bill becomes law.

And to think that a little, a very little, more activity on the part of electrical contractors could have easily prevented the second reading, which was carried by a majority of six only!

Now, how will the general public benefit by this proposed municipal competition? Unless they get their wiring, fittings, motors, &c., cheaper, it is difficult to see where the general public come in. And if the councils carry out work at cheaper rates than contractors are prepared to do it for, they certainly cannot make it pay. The profit on electric wiring, owing to the keenness of competition, is cut so fine that it is only by keeping the fixed charges down to the irreducible minimum and the turnover up to the maximum, that most contractors manage to exist at all. How, then, can a municipality, with its costly administration, expect to make it pay? By excluding rents, rates, taxes and establishment charges generally, a paper profit may be shown, but the contractor who lives on this kind of profit soon finds himself in the Bankruptcy Court.

No matter how we look at it, we can see nothing to justify municipal competition with the private enterprise of the ratepayers. If the municipality make a profit on trading, then that profit ought, by rights, to have gone to a rate-paying trader; if, on the other hand, it make a loss, which is more probable, the ratepayers who bear this loss, are helping to crush out of existence some fellow-tradesman, who, perforce, is assisting in his own ruin.

There appears to be an extraordinary idea current, even among men who are supposed to be well informed, that so long as a municipality makes no profit on trading, no harm is done. Thus, in the *Times* for May 26th, we read that the manufacturers of gas fittings in Birmingham, who are large ratepayers, have for some time complained of the unfair competition of the Corporation in dealing with gas fittings. Mr. Chamberlain was the mayor of Birmingham when the gas undertaking was purchased, so a manufacturer recently wrote to him pointing out the injustice complained of. Mr. Chamberlain replied that at the time the business was purchased by the Corporation, the gas company were doing a certain amount of trade in connection with their own fittings, and this was continued by the Corporation with the rest of the business, "but there was no intention of enlarging it, or of carrying it on with any view to profit."

Well, if Mr. Chamberlain cannot see the injustice of a corporation competing at a loss with its own ratepayers, who have to bear the loss, when they themselves might have made a profit, it is little wonder that he is so ill-informed on the larger issues which are disturbing the country.

And, reverting to the L.C.C. proposals, let it be remembered that this is as much a manufacturer's as a contractor's question.

The proposals are to deal not only with wiring matters, but with the supply of fittings and motors. True, they do not propose to manufacture, but what does it mean? A contract will be given to a company for the supply of motors for a year; and then, as the representative of a leading motor-manufacturing company informed us a few days ago, "all the rest of us may as well close our offices, and take a long holiday."

It should not be left, then, to the Electrical Contractors' Association alone to fight this battle; the manufacturers who really depend on the contractors for orders, must help, as must also the contractors outside the Association.

It is necessary, says the *Electrical Contractor*, that £1,000 should be guaranteed, and as there are between 400 and 500 electrical contractors in London alone, in addition to manufacturers, this is not a large sum. And let those manufacturers and contractors in the provinces remember that if the L.C.C. win this fight, their turn will come.

The Workmen's Compensation Act.

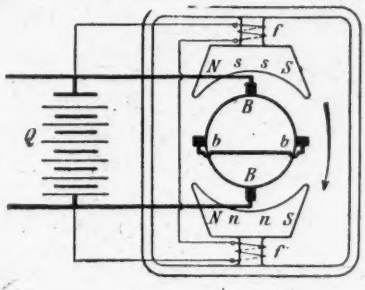
Although the Workmen's Compensation cases which have recently been considered in the Court of Appeal do not specially affect the electrical world as apart from other industries, nevertheless there are one or two points decided which should be noted by all employers who may be held liable to pay compensation under the Act. First and foremost comes the question, Who is a workman within the meaning of the Act? This is a question of such great importance that one would have thought that it was fully answered already in the course of numerous reported decisions, but two recent cases seem to show that the term is not yet defined with sufficient accuracy. In the first of these the facts were, shortly, that a man who owned a small surface mine took two other men into partnership with him. Each partner received a share in the profits of the undertaking; but, in addition to this, while actually engaged in manual labour at the mine he received weekly wages. One of the partners met with an accident which caused his death. His widow sought compensation under the Act from the surviving partners, on the ground that her husband had been injured in the course of his employment. The Court of Appeal very properly rejected this contention, holding that it was impossible for a man to be his own employer. In another case a claim for compensation was made on behalf of the widow of a colliery manager. It will be recollected that the Act applies to employment in certain industries, whether by manual labour or otherwise. It was argued (in effect) that the words "or otherwise" operated to extend the definition of the term workman to all the persons so employed. In the case in question, it was shown that the colliery manager received a salary of £400 a year and a house, and that he did no manual labour of any kind. The County Court judge held that the manager was not a workman within the meaning of the Act, and the Court of Appeal supported this decision, holding, further, that the question was really one of fact for the County Court judge. Further, the Master of the Rolls said that the whole tenour of the Act was against the contention that its provisions were applicable to anyone but a workman in the common acceptance of that term. One other case merits attention. The Act applies to (in effect) employment on, in, or about, a building which exceeds 30 ft. in height. The Court of Appeal puts a very wide interpretation on this provision. In one of the recent cases it was shown that a workman was employed in the erection of an addition to a generating station. The addition did not exceed 30 ft. in height, but it was argued that inasmuch as it was to be attached to a building which did exceed that height, the employment came within the Act. This argument was allowed to prevail. It is obvious from this, that if the Legislature ever intended to differentiate between a high building and a low building on the ground that employment in a high building is more dangerous than employment in a low building, this intention is negatived when the Court rules that the mere physical attachment of a low building to a high is sufficient to make employment on the former employment within the meaning of the Act.

A NOVEL TYPE OF DYNAMO.

[By our Berlin Correspondent.]

A novel type of direct-current dynamo, which is especially suitable for the lighting of railway trains, giving, as it does, a current of constant intensity without the aid of any auxiliary apparatus, has been designed by Dr. E. Rosenberg,

Fig. 1.



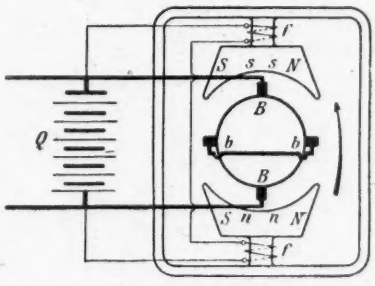


Fig. 2.

and is being brought out by the Allgemeine Elektricitäts-Gesellschaft.

The transverse field at right angles to the primary field, which occurs in every ordinary dynamo, gives rise to inconvenient deformation of the main field, the effects of which

Fig. 3. Fig. 4.

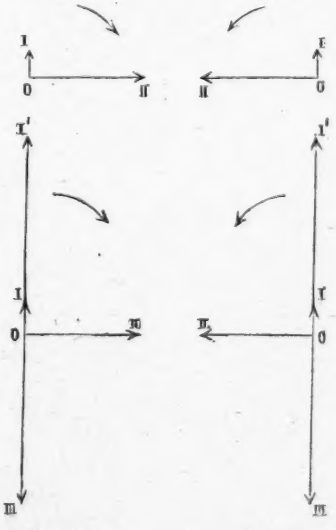


Fig. 5. Fig. 6.

have to be counteracted by various means. Now, however, this transverse field has been turned to practical use by the inventor.

In figs. 1 and 2 is represented a somewhat unusual type of two-pole dynamo, the parts of which, apart from the dimensions, are identical with those of an ordinary machine, while a second pair of brushes, B B, has been added. The brushes *b b*, corresponding to those of an ordinary dynamo, have, however, been short-circuited.

As regards the magnetic conditions of this machine, its original field, the flux of which, for example, leaves the lower pole and travels upwards through the armature towards the upper poles, may be very small in the event of the machine running at full speed. It suffices to induce a small E.M.F. in the armature to drive through the latter the normal current or part of the same, while the brushes are short-circuited. This original field is represented by 0 I in figs. 3 and 4. In figs. 1 and 2 the polarity of the pole-shoes due to the original field is denoted by *n n*, *s s*. The armature current will produce a transverse field of much greater intensity than the primary field, and displaced 90° in the direction of rotation; its axis of symmetry is horizontal. Now, it is well known that the armature reaction will always weaken the field in the leading edge of the pole-shoes, while reinforcing it in the trailing edge. If the armature be rotated to the right (fig. 1), there is, therefore, always superposed a north pole upon the left-hand half of the upper pole-shoe, and a south pole upon the right-hand half, and similarly in the case of the lower pole-shoe. The polarities due to the primary field will be combined with those of the transverse secondary field, to form one resultant field.

This superposition of fields of greater intensity upon the original field has been represented in the diagram of fig. 3, where the secondary field 0 II is in advance of the primary field 0 I by 90° in the case of a right-hand rotation, and *vice versâ* in the case of an opposite rotation (figs. 2 and 4). The brushes B B in the vertical axis are influenced only by the horizontal field 0 II, and as this field becomes reversed with opposite rotation, the brushes B B will yield current of constant direction.

Now let these main brushes be connected with any external resistance. The armature current derived from them will obviously generate a field transversal with regard to the acting field, and in advance by 90° in the direction of rotation (0 III in figs. 5 and 6). This tertiary field is thus displaced with respect to the secondary field by 90°, and with respect to the primary field by 180°, in either direction of rotation. If the current derived from the main brushes be greater than the auxiliary current flowing between the short-circuited brushes, 0 III will be greater than 0 II in the diagrams of ampere-turns. In order to allow the above armature current to develop perfectly, a further number of ampere-turns should be arranged on the magnet system, as represented by the line I I′ (figs. 5 and 6), accurately counterbalancing the back turns of the armature. If the machine were to be designed for ordinary purposes, the number of ampere-turns I I′ would be reduced by an additional main current winding, so as to compensate for the armature reaction at any load. With such machines, however, as are intended for working in parallel with accumulators, and especially in the case of train-lighting dynamos, which are driven from the axle, a quite different practice should be adopted. The primary exciter coils, which, for example, are connected to the accumulators, will have to be calculated so that the number of ampere-turns 0 I′ is present from the very outset. This fact is of the greatest importance. It should be mentioned that, with medium speeds, the number of ampere-turns required for generating the primary field is about 10 per cent. of that necessary for the armature compensation. The exciter coil thus receives a number of ampere-turns only greater by 10 per cent. than the number required for the compensation of the normal effective current, while the current flowing between the short-circuited brushes is about 40 per cent. of the normal effective current. Any increase in the latter weakens the primary field, and accordingly weakens the magnetising current between the auxiliary brushes. Though the speed may increase up to double or a higher multiple of the average speed, the effective current in the armature will obviously never increase more than 10 per cent. beyond its actual value. In fact, on reaching this value, the armature ampere-turns would be perfectly equivalent to the primary ampere-turns, so as to leave no primary field. Even with infinite speed, this value cannot be exceeded, as shown above. If, on the other hand, the speed falls below the average—*e.g.*, by 70 per cent.—the effective current will tend to decrease. If, however, a decrease of only 10 per cent. has taken place in the latter, the

primary ampere-turns will have an excess twice as great as before, and will generate a primary field twice greater, and this in turn produces, in spite of the lower speed, a current about 40 per cent. stronger between the auxiliary brushes, so that the increase of the secondary field is practically inversely proportional to the speed.

The ampere-meter or voltmeter of a dynamo of this type, which has been connected to a resistance, and the speed

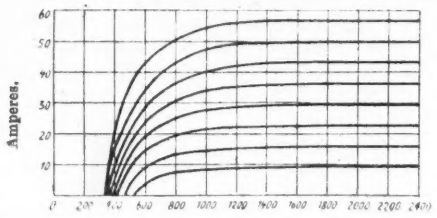


FIG. 7.

of which is regulated from the maximum down to the smallest value, will remain nearly immovable, especially in the event of the machine working at relatively small voltage. The machine accordingly regulates itself to a practically constant current strength. If the external circuit contains a constant resistance, a pressure of nearly constant value will be obtained from a given minimum speed, while, in the event of a storage battery being inserted in the external circuit, the pressure will depend on the number of cells and the state of charge of the battery. The dynamo voltage adapts itself to the voltage in the mains.

In fig. 7 is represented the relation between the current and the speed when working in parallel with a battery, the system of curves representing the current generated with different excitations and varying speed. It will be seen that from 800 r.p.m. to infinite speed, the current is practically constant. If, on the other hand, the exciting current be altered by means of the shunt regulator, the minimum speed at which con-

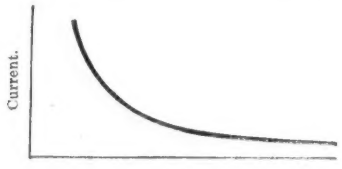


FIG. 8.

stancy is obtained, will be only slightly higher than in the former case. In fig. 8 is shown the relation between the current flowing between the short-circuited auxiliary brushes and the number of revolutions per minute with constant pressure. The auxiliary current curve is seen to approximate to a rectangular hyperbola.

The curves representing the current and pressure when working on constant external resistance (fig. 9) obviously pass through the origin, and are of similar shape to the curves of fig. 7.

The machine characterised by the curves in figs. 7 to 9 is intended for a railway running under peculiar conditions, such that only very low and very high speeds have to be taken into account. But if the machine is used with the same arrangement, but without accumulators, and with constant speed but variable external resistance, its behaviour will be as follows :—The current given by the armature will, independently of the magnitude of the external resistance, assume so high a value as to nearly counterbalance the ampere-turns of the primary field. If the latter be excited at a constant value, and the external resistance be augmented, the effective current will decrease only very little, while the pressure rises nearly in proportion to the external resistance. Let the point *m* in fig. 10 represent the normal load. It will be seen that even on short-circuiting the machine (zero voltage) and maintaining the separate excitation constant, the current increases only slightly, while, on the other hand, a decrease in the external current corresponds with a considerable increase in the voltage. If the external circuit be broken entirely, the voltage will be a high multiple of the normal value, while the current between the auxiliary brushes increases accordingly. This machine, therefore, need not be protected against short-circuits, but rather

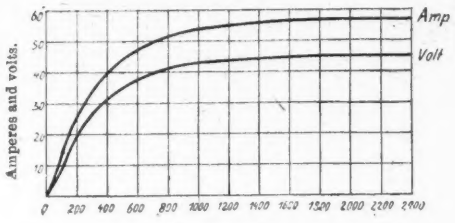


FIG. 9.

against the interruption of the external circuit, and for this purpose a lead fuse is inserted between the auxiliary brushes. In order that the exciting current might be altered simultaneously with any variation of the external resistance, series windings connected in the same sense as the shunt windings could be used. It is evident that this machine is highly

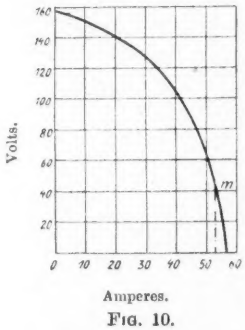


FIG. 10.

suitable for train lighting purposes, performing with absolute certainty the same duties for which otherwise auxiliary apparatus of different reliability would be required.

In a lecture recently delivered before the German Society of Electrical Engineers, the inventor showed that in case such a machine is mainly intended for operation with higher speeds, the losses due to the auxiliary current need hardly be taken into account in calculating the armature. The effective value of the resulting current is found (exactly as in the case of a combination of two alternating currents showing a displacement in phase by 90°) as the diagonal of the corresponding rectangle. If operation at lower speeds occur for some length of time, the copper cross-sections in the armature should be given correspondingly greater dimensions.

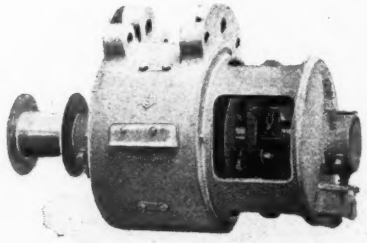


FIG. 11.

The arrangement of the magnet system results in a great saving, and the poles and yoke of the magnet may have remarkably small cross-sections.

As regards commutation, the auxiliary brushes (*b b* in figs. 1 and 2) work under considerably more advantageous conditions than those of a normal machine. In fact, the auxiliary current being only a fraction of the normal current, the reactance voltage is only a fraction of the normal voltage. As the angular speed is diminished, the intensity of the auxiliary current

increases approximately in proportion to the decrease in speed (fig. 8), the product of the two, on which the reactance voltage depends, will be nearly constant, and the brushes will be free from sparking.

As regards the main brushes, these are placed just in the centre of the pole shoe, which would be very objectionable

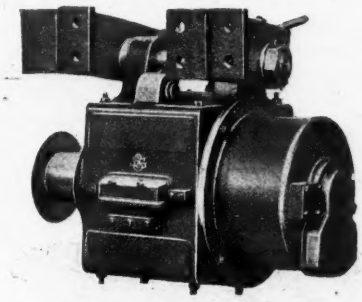


Fig. 12.

in the case of a normal machine; with regard to the main flux of the secondary field, the brushes are placed on the neutral line, while the primary field is just strong enough to give rise, in the armature coil short-circuited through *b b*, to a current of determined magnitude. The brushes, B B

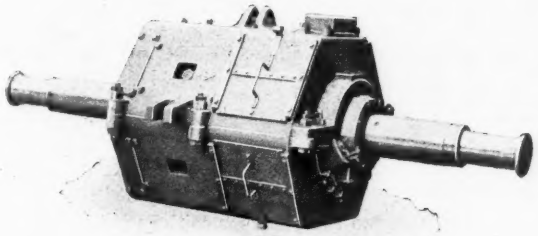


Fig. 14.

(figs. 1 and 2), are placed in a field which is favourable for commutation. The poles, *s s*, and *n n*, of the primary field are just 90° behind the poles, S S and N N, so as to be *commutation poles*. These commutation poles are, however, not indispensable, and in several machines a slot has been arranged in the middle of the pole to give a neutral line. The brushes work without any sparking at any speed and in either direction of rotation, and both the main and the auxiliary brushes work exactly in the same manner.

The C^2R losses in the armature, as well as the iron losses, are no higher than in a normal machine. On the other hand, the friction losses on the commutator are greater, while the losses in the magnet coils are smaller than in a normal shunt machine, and considerably smaller than in a compound machine such as would be used for the lighting of trains. The total efficiency is therefore quite as good as that of an ordinary machine, and practically constant between wide limits. The efficiency is obviously far greater than in such systems as obtain regulation by a destruction of mechanical energy, *e.g.*, by the slipping of a belt.

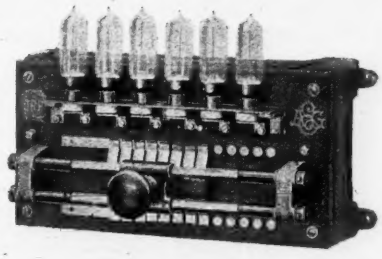


Fig. 13.

Fig. 11 shows a machine (with cover removed) which has been constructed on the above lines and supplied to the Royal Bavarian State Railways. In fig. 12 is seen a somewhat similar two-pole machine with the brackets, by means of which it is fitted to the truck of a railway car and with the brush cover in position.

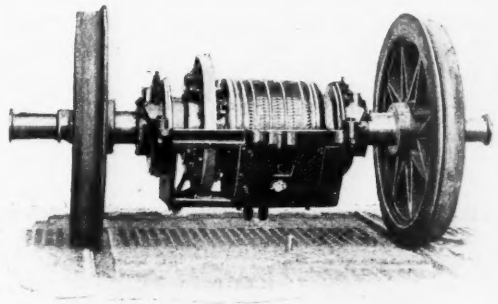


Fig. 15.

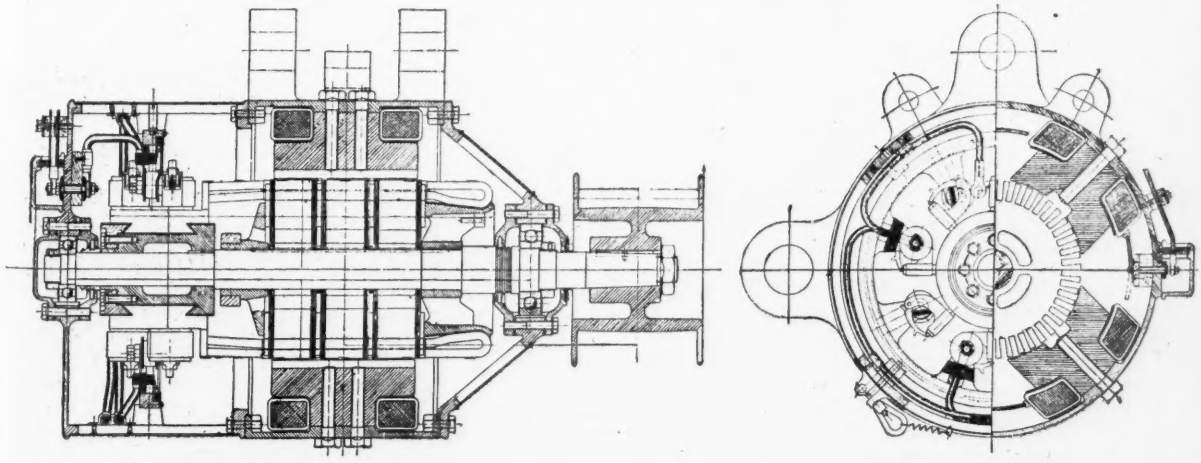


Fig. 16.—Sections through Rosenberg Four-Pole Train Lighting Dynamo.

In figs. 14 and 15 is seen a six-pole machine constructed to the order of the Royal Prussian Railway Department for a mean pressure of 77 volts and a current of 200 amperes at 165 to 530 r.p.m.; this machine, which is intended for the lighting of a whole train, is located directly on one axle of the van. In fig. 13 is represented a shunt regulator, as used for this type of machine by the Allgemeine Elektrizitäts

Gesellschaft. This contains a number of iron-wire resistances, all or part of which are connected in parallel, according to the position of the regulator, and which serve a double purpose—on one hand they keep the exciter current constant, independently of the state of charge of the accumulators; on the other hand, they form a safety device providing against excessive voltage.

Apart from its use in connection with the lighting of trains, the new machine can obviously be used also for any similar duty, *e.g.*, for operation by water or wind-mills, while, on the other hand, it will prove an excellent generating machine for constant current series circuits.

REVIEWS.

Electricity Control. By LEONARD ANDREWS. London: Charles Griffin & Co. 1904. Price 12s. 6d. net.

The author need not have apologised for adding this book to the library of electrical engineering, because no one had previously dealt exclusively with that part of an electrical system which may be called the "nerve centre." A book by such a specialist and careful observer as the author is well worth reading, and the fact that he, in explaining the causes of failure, has referred to much apparatus which is now out of date, is quite excusable, for one always learns most from the failures. The illustrations number over 200, and they are exceedingly well chosen and, in the case of the line drawings especially, well executed.

Under the heading of connectors, the split cable socket, which is bored with a parallel hole of slightly smaller diameter than that of the turned pin, to which it is gripped, is illustrated. The design of laminated contacts for switches is gone into with considerable detail, as well as the insulation of contacts.

Referring to circuit-breakers, the system in the United States of defining a switch as a device corresponding to a plug for *directing* the flow of current is mentioned. A "switch" under this phraseology is never used to interrupt the circuit when it is carrying a heavy current, circuit-breakers operated automatically or by hand being used instead. In connection with the magnetic blow-out circuit-breakers, Prof. Bertram Hopkinson's experiments are referred to, in which he found that under some conditions the magnetic blow-out was liable to cause excessive rises of pressure.

The Schuckert horn break switch is illustrated, in which curved metal horns, each consisting of two pieces of $\frac{1}{4}$ in. rod, project vertically upwards from wedge-shaped plungers which fit between the horns. In switching off, a main connecting blade is first withdrawn and then the wedge-shaped plunger. On the latter being removed an arc is started between the lower extremities of the horns, which runs rapidly upwards, increasing in length until it reaches the distance at which the pressure is incapable of maintaining the arc. The upward movement is not only due to the upward draught of air resulting from rise of temperature, as is commonly supposed, but is largely due to magnetic repulsion, and this the author has confirmed by some interesting experiments detailed in the book.

Some amount of space is rightly occupied with oil break switches, and the modern American types of large power three-phase circuit-breaker, both pneumatically and electrically controlled, are described. Naturally, the author goes into great detail in connection with his pet subject of discriminating cut-outs. Whatever engineers may think of the merits of these, they cannot fail to be interested in the descriptions of the various devices.

The book concludes with an excellently written chapter headed "Long-Distance Transmission," under which are discussed various forms of lightning arresters and choke coils, the Cowan-Still regulating transformer and insulators, leading-in wires, cable charging devices, &c.

No central station engineer can afford to be without this book, and a copy ought to be found in every manufacturing works' library.

Notes on the Construction of Cranes and other Lifting Machinery. By E. C. R. MARKS. Manchester: Technical Publishing Co. Price 3s. 6d. net.

Literature relating to crane work is in this country somewhat scanty, so that this work, though unpretentious, is welcome.

The author does not go deeply into either the science or the practice of his subject, but rather restricts himself to a general survey which, considering that the work is small and covers the whole range from hand pulley blocks to 150-ton electric cranes, is as much as could very well be accomplished.

Hand pulley blocks and crabs are first treated, the calculation of purchase of rope, ratios of gear and various mechanical dimensions being dealt with. The various types of jib cranes follow, examples of stress diagrams for the jibs, &c., being given. Overhead cranes for hand, rope and electric driving are illustrated and described. Hoists both for goods and for passengers receive attention, and there is a chapter on hydraulic jacks and another on chains and ropes.

In Part 2 considerable space is devoted to the description of a number of patented inventions relating to lifting machinery.

Part 3 consists of examples of present practice by leading makers, and includes steam titans, shear legs, electric and hydraulic cranes, transporters, lifts and pneumatic hoists.

La Bobine d'Induction. By H. ARMAGNAT, Chef du Bureau des Mesures Electriques des Ateliers Carpentier. Paris: Gauthier-Villars. Price 5 fr.

This French book on the induction coil is deserving of an English translation, to bring its contents within the reach of those whose studies in the language never progressed beyond the school primer stage, which tells us, *inter alia*, that "the uncle of our coachman has pens, ink and paper," but fails to embrace such technical expressions as the square root of the mean square, or the number of ampere-turns in a coil of wire.

Some few years ago the induction coil was regarded more or less as a scientific toy, useful for purposes of experiment and demonstration in the lecture room, but having no place in the commercial development of electrical engineering. With the advent of X-rays, wireless telegraphy, electrical ignition for petrol motor-cars, &c., however, it leapt into prominence as a very necessary and important auxiliary, and the need for special considerations in the design of such coils to meet the requirements of individual cases at once became apparent. The above work, embracing as it does the history, theory, principles of construction, and practical applications of the induction coil, comes therefore at an opportune time.

Two features of the book which call for special mention, and which might be adopted with advantage by other technical writers are, first, the table of symbols, or notation employed throughout the book, which saves the reader much of that annoying back reference in reasoning out formulæ or calculations; and, secondly, the assembling of all references to contemporary literature in the form of a final chapter or appendix, with numerical index, the various references in the context being made by means of bracketed numbers. The latter feature renders the book more valuable as a work of reference, especially in the historical section.

The introduction, comprising as it does a simple description of elementary principles, is naturally brief, and is followed by Chapter II., in which the history of the induction coil is very fully dealt with.

Theory, as is only to be expected, takes up a considerable amount of space, some 60 pages, and is divided between two chapters, according to whether the coil is furnished with an interrupter of the mechanical, or the electrolytic type, the results in either case being widely different, owing to the varying speeds of interruption, and the phenomena which accompany the action of each type. The matter is treated very fully, and the accompanying curves are well chosen for the purpose of illustrating the various points put forward in the context.

Chapter V. deals with the Secondary Current, one of its most interesting features being a detailed account of the

production and behaviour of sparks, which is very clearly expressed in diagram form.

Chapter VI., on the Power, Output, and Efficiency of Induction Coils, is also clearly rendered, and includes some useful notes as to the why and wherefore of adopting certain definite types of measuring instrument in making the required tests. There is also some valuable information in this section on the detection of various faults in coils.

Chapter VII., on Construction, is essentially practical, and profusely illustrated, as is also Chapter VIII., on Interrupters, which comprises a very full description of practically all types, from the simple vibrating spring make and break, to the latest developments of the Wehnelt and Caldwell types of electrolytic interrupter.

Chapter IX. is comparatively short, and embraces a description of one or two special forms of coil construction —*e.g.*, the Tesla transformer.

Chapter X. comprises a brief account of each of the various applications of the induction coil in practice, including a very clear and well-illustrated description of the principles of electrical ignition for internal combustion engines, a feature which will appeal to the automobilist.

The printing and illustrations generally redound to the credit of the publishers, whilst the book is bound in that convenient flexible cover peculiar to French technical productions, but well worthy of imitation in British books of a similar character.

Electric Lighting: A Practical Exposition of the Art. Vol. I.—The Generating Plant. By FRANCIS B. CROCKER. London: E. & F. N. Spon. 1904. Price 12s. 6d. net.

Prof. Crocker has accomplished the always difficult task of bringing a text-book up to date, in a most successful manner. The rapid advance which is still being made in electrical engineering, particularly in the design of large central stations, the application of the steam turbine and gas engine, and the development of electro-chemistry and electro-metallurgy on a commercial scale, together with the great growth of traction systems, renders the re-issue of a text-book originally published nine years ago a more than ordinarily heavy undertaking. As a general elementary survey of modern generating plants, the book under review is concise and comprehensive. Prof. Crocker classifies the principal systems now in use, stating the conditions which govern the selection between them. He then deals with the most suitable position and general arrangement of the station, and gives certain information concerning the buildings required. A discussion of the possible sources of energy is followed by chapters on the steam engine and boiler, these being dealt with rather fully, more particularly as concerning electricity supply. Following on this, the gas and oil engine is treated, together with liquid and gaseous fuels, and the application and possibilities of wind and water are discussed. We then have a link between the mechanical and electrical portions of the book in the shape of a chapter on "Mechanical Connections Between Engines and Dynamos," after which there is a sequence of chapters on dynamo-electric machines, their underlying principles, construction, application to electric lighting, and practical management. The chapter under this last head is to be particularly recommended. After a discussion of secondary cells and systems of storage, switchgear is dealt with, and typical switchboards illustrated. Electrical measurements and measuring instruments are then briefly outlined, and the book closes with a chapter on lightning arresters, presumably because, in a country where overhead transmission is so prevalent, these are the last pieces of apparatus in the neighbourhood of the current as it passes to the distributing system, described by Prof. Crocker in a second volume, which, we understand, is now in the Press.

To deal with such a huge programme in a book of 480 pages in more than a general manner is, of course, impossible; but the common-sense method of treatment, being in effect a tour through the station in the path of the energy from the coal-heap, or weir, to the bus-bars, and the references to more specialised works, with which the book abounds, help the student to a well-balanced knowledge of his subject. Certain details appear, however, to us to be blemishes in an otherwise excellent book. For example, on page 84 of the copy before us, there is a quarter-page blank, due possibly to a slip on the part of the publisher, which creates a regrettable hiatus in the treatment of "possible sources of electrical energy." In discussing "buildings for electric light plants" more attention might have been drawn to the importance of fireproof buildings, of whatever size and purpose. The "Standard Electric Light Station," illustrated on page 62, shows a wood roof, a wooden floor, a wooden basement floor laid on coal-tar concrete, and a wooden temporary end. The statement that "corrugated iron is unsatisfactory, as it rusts out rapidly," is contradicted by the number of tin tabernacles in this country, regarded by their trustees as permanent structures. Again, in an elementary practical handbook the statement that coating the interior of an engine cylinder with varnish tends to reduce cylinder condensation, gives such an experimental method undue prominence, and we should have been more satisfied if Prof. Crocker had set his face unflinchingly against the use of "oak, hemlock, and other barks" in the interior of boilers, and had given no countenance to the use of oil (even a "high-grade kerosene") in boilers to loosen scale. We should have preferred one or two scale-drawings, or shaded-section illustrations, after the manner of that on page 217, to the numerous photographs appearing in the section on "Typical Forms of Generators," which are more illustrative than instructive. These are, however, only minor points, and detract but little from the usefulness of a work which, with its inclusion of the "Climax" boiler, the Westinghouse gas engine, and the Edison storage battery, will be seen to be well up to date.

PARLIAMENTARY.

The Telephone Agreement.

(*Continued from page* 888.)

Wednesday, May 31*st.*

SIR R. HUNTER was recalled with reference to the words in the agreement as to the undertaking of the company being purchased at a fair market value.

WITNESS said that in the Electric Lighting Act of 1888, which enabled local authorities to purchase electric lighting undertakings, the words used in the clause were that the local authority shall purchase and the undertakers shall sell upon terms of paying the then value of the land, material, works, &c., and the clause went on to say that the then value shall be the fair market value, due regard being paid to the state in which the plant, &c., were in at the time of the purchase. These were exactly the words which were used in the agreement now before the Committee. He believed that no purchase had taken place under the Electric Lighting Acts, because the period was 42 years from 1882. There had, however, been a purchase of an existing company. The Marylebone Borough Council obtained a special Act for the purchase of the undertaking of the Metropolitan Electric Supply Co. within their area, but the authority they obtained was under the Lands Clauses Act, and under this they had to pay for goodwill and make allowance for compulsory purchase.

The CHAIRMAN: And these things are guarded against by the present agreement?—Yes.

WITNESS was questioned at some length by MR. BENN as to whether he would be prepared to substitute the words in the Tramways Acts as to purchase for the words in the agreement. He said he thought it would be a great pity to alter the agreement. He did not know that it was very material one way or the other, but he preferred the words in the agreement as they stood. The words spoke for themselves, whereas for the words in the Tramway Act they had to refer to legal decisions to find out what they meant, and in the course of these decisions it was pointed out that the words were not satisfactory. He did not think that words on which there had been a decision were necessarily more valuable than words on which there had been no decision. He agreed that there was no necessity to include the words "good will," because there could be no goodwill when the licence of the company expired in 1911. The words "fair market value" simply meant fair market value, and if an attempt were made to interpret the words differently, it would be against the company, because the only possible purchaser was the Postmaster-General.

MR. H. BABINGTON SMITH, Secretary to the Post Office, was called, and stated that he was familiar with the policy of the department which led up to this agreement. The main idea of the policy had been that the telephone service of the country should ultimately be in the hands of one single administration, and that administration should be the Post Office.

Questioned as to the views of the Post Office as regards competition, WITNESS said that competition between rival systems in the same locality could not be regarded as a satisfactory arrangement for a telephone service in permanence. It might be desirable as a temporary measure, and it was recommended by Mr. Hanbury's

Select Committee of 1898 as a temporary measure and for special reasons. There were several objections to competition. In the first place, if there were a genuine competition it meant that any subscriber who wished to communicate with all telephone subscribers in the town, would have to subscribe to both systems, and this meant additional expense and inconvenience. The special reasons which led Mr. Hanbury's Committee to recommend competition were, firstly, that it would extend and popularise the telephone system; and, secondly, it would prevent the undertaking of the Telephone Co. being foisted on the country at an inflated price. He had good reasons for saying that both these objects had been obtained.

The CHAIRMAN: Coming to considerations of finance and economy, there is also the fact that the Post Office has already to keep a large engineering and administrative organisation for the purpose of telegraphs?

WITNESS said that was so. They had to maintain an organisation throughout the country for telegraphs, and from the public point of view, there was economy in applying that same organisation for the construction and maintenance of telephones. Moreover, as the telephone service was a growing service, and the telegraph service was, owing to the competition of telephones, a stationary service, and one even likely to go backwards in the future, it seemed clear that an undue burden would be cast on the exchequer if the organisation throughout the country were to be kept up for a service which was diminishing, whereas an organisation for an increasing service would be kept up by the licensee. It was these considerations which led the Department to adopt the policy of unification. In 1895 Sir Wm. Preece estimated that it would take five years to construct a service equal to the then existing service of the Telephone Co., but that service was much larger now, and would, of course, be much larger in 1911. It had to be remembered also that if they constructed a new system there would be a heavy charge for interest during construction. The question of purchase immediately was gone into in 1904, but negotiations showed that there was such variance as to price that there would have been no benefit in pursuing the negotiations on those lines. The general effect of the agreement was that the Postmaster-General was under no obligation to buy antiquated or inefficient plant. In competitive areas where there had been a duplication of plant, the Postmaster-General was under no obligation to buy more plant than was suitable for his requirements at the date of the purchase.

The CHAIRMAN: Then he is safeguarded as regards both quantity and quality?—Yes.

Continuing, WITNESS said that as regarded price, the main point of the agreement was that it was drawn so as to exclude any payment from the earning power of the company. He thought the words used in the agreement made it absolutely clear that payment with regard to earning power was absolutely and entirely excluded, except in the comparatively insignificant area where the company had power to continue its business where there was competition. In the case of the private wire business, the purchase price would be on the basis of three years' net profits, and he did not think that was unreasonable, as there was no time limit to the company carrying on this business. As regarded new plant, a clause was inserted under which the Postmaster-General undertook to construct works for the company under conditions which gave him great liberty. He felt that such a clause was desirable from several points of view. The plant would be the property of the Postmaster-General, and this would minimise the magnitude of the operation of the transfer of the company's business. In addition, without this clause the company would probably not, in the last few years of their licence, put in such good plant as they now would.

Sir WM. HOLLAND: Who is to be the judge as to what is obsolete plant?—The question is whether it conforms with specification. It is probable that no question would arise, but if there were any difference on this point, the arbitration clause would cover it.

Does it appear to you that the public are likely to be gainers by the transfer?—I think the agreement will tend to benefit the public in the matter of rates, but rather indirectly than directly. It will avoid overlapping and waste. I do not think rates will be uniform, nor do I think they should, because the service a man gets in London is much greater than a subscriber would get in a small town.

You think it is a fair agreement as between man and man?—Yes.

The Stock Exchange seem rather to consider that a profit has been given to the Telephone Co. as the market value of the shares went up?—As a matter of fact, I believe the shares are lower now than when the agreement was published, but I guard myself against admitting that the Stock Exchange valuation is necessarily the correct one.

Questioned by Mr. PLUMB as to the method of procedure for the acquisition of the Telephone Co.'s undertaking, WITNESS said he took it the first step would be to determine what portion of the plant they proposed to buy, and then proceed to a valuation. It would be a matter for consideration at the time whether any offer would be made *en bloc* or in detail.

Tuesday, June 6th.

The evidence of Mr. BABINGTON SMITH was continued, and in reply to Mr. BENN, said he saw nothing inconsistent in the policy embodied in the agreement, and the policy recommended by Mr. Hanbury's Committee in 1898. The recommendation of the Committee of 1898 distinctly contemplated that after the lapse of the National Telephone Co.'s licence in 1911, the Post Office should purchase the plant of the company, and also of its competitors. There was no doubt that it was the general intention of Mr. Hanbury's Committee, that in order to secure the advantageous purchase of the National Telephone Co.'s undertaking, the Post Office should immediately set about the installation of a system, and that municipalities should also be encouraged in other areas to do likewise, said that when the time of purchase came, the State would have not only a considerable plant of its own, but also the option of purchasing the modern telephone plant provided by other local bodies.

Mr. BENN: May I ask if that intention is still the policy of the Post Office?—I think that policy was recommended for a temporary purpose, and that purpose having been obtained, the pursuance of the policy in the exact form stated is no longer necessary.

But that policy clearly stated that there was to be set up with State money an effective system alongside with the National Telephone Co., so that when the time of purchase came, the position of the State as the purchaser would be a very favourable one?—If it was the intention of the State to purchase the plant of the National Telephone Co., it would obviously be wasteful to set up a complete parallel system.

Continuing, WITNESS said whatever was said by Mr. Hanbury in 1898 bore no application to the present circumstances. There had been a considerable expansion of the system, and old plant had been replaced by new plant. It was probable that Mr Hanbury, at the inauguration of the Glasgow municipal telephone service, said that the Glasgow Corporation were battling on the side of freedom, but Mr. Hanbury was an enthusiast on municipal competition. If the same objects were obtained by the agreement in the country as were obtained by the setting up of a competitive system in London, it would certainly be wasteful to extend the competitive system. With regard to the rates charged in London, he had not heard of many complaints during the last few years. It was true that the Postmaster-General in 1902 promised that in three years' time there should be a reconsideration of the rates, and a committee had just been appointed to consider whether the rates were adequate or were too low. The Committee had not yet commenced their task, but they were all ready to start. He could not prophesy what the result of the Committee's deliberations would be, but the difficulty in regard to rates was the unlimited service rate. He was not aware that the late Mr. John S. Forbes at a meeting of the National Telephone Co. stated that but for the Post Office royalties, the company would be able to reduce the charge to under £12. There was very great difficulty in fixing a rate for an unlimited service, because while the rate might be all right when the system was a small one, it might be altogether unproductive when the system had grown to a large one. In the case of plant put up before the date of the agreement, if the Postmaster-General objected to it as not being in accordance with specification, his objection was liable to be disputed and taken to arbitration by the company.

Mr. JOHN GAVEY, engineer-in-chief to the Post Office, said that before 1902 he was assistant engineer and principal technical adviser. He made the valuation in connection with the trunk lines when they were purchased by the Postmaster-General, and had also been responsible for the setting up of the Post Office telephone system in London. He was familiar with the agreement, and had advised the Postmaster-General on the various technical questions which had arisen. From experience he had acquired with reference to the construction of telephonic plant, he had no hesitation in saying that it would require at least seven years to construct a telephone plant equivalent to that which the Telephone Co. now possessed, and the additional plant which they would possess at the end of the period, allowing for normal growth and the necessity of putting down a reasonable amount of spare plant. In fact, if the Post Office had contemplated the erection of a new alternative system, the preliminary surveys throughout the country ought to have been taken in hand last year. When he received instructions to telephone London, the first question for consideration was the capacity of the ducts and pipes which had to be laid in the streets of the metropolis, and it was necessary to make a systematic survey of the whole of the streets to get at this. Then they had to consider the question of exchanges, and in most cases it was necessary to acquire premises. There was also considerable difficulty experienced with regard to wayleaves, and altogether the initial work took about four years. As soon as the Money Bill was passed they gave orders for the manufacture of necessary material, and in 1900 the works were actually commenced, and the first exchange was opened in 1902. It was necessary in carrying out works of this character to design switchboards and pipes for a much larger number of subscribers than would be obtained at first, and they made arrangements for 60,000 pairs of wires, and 18,000 wires were drawn into the Central Exchange before a single subscriber was obtained. The London works had been in progress up to the present day, and they were making provision now for about 80,000 telephones. If the suggestion was for the Postmaster-General to replace the existing plant of the Telephone Co. in London and the provinces, it would mean providing immediately for 70,000 subscribers in London and 245,000 in the provinces. In London there had been no attempt to duplicate the company's plant, but the plant put down was for additional subscribers, and as many subscribers had joined the company's system as the Post Office since.

The CHAIRMAN: Is it true to say that what has been done in London on behalf of the Post Office is no guide because the plant was provided for new subscribers?—Yes. If it were necessary to replace the company's plant absolutely it would mean the spending of about 2½ millions of money for five years and two millions for one year, and the greater part of the expenditure would be unremunerative until 1912. The interest charge at 3 per cent. would mean during that period £1,483,000.

Proceeding, WITNESS said that he was estimating for a system three

time as large as the company's present plant. If the Post Office set up such a system, it would probably be four or five years before they could take any subscribers at all. After that period they could begin joining up such exchanges as were ready, but he did not think they would obtain a sufficient number of subscribers to do more than pay current working expenses. The question of wayleaves also was a formidable one in the duplication of plant. Local authorities were becoming more and more sensitive as to the use of the roads. He agreed that for an economical and efficient telephone service for the country, all the telephone exchanges should be in one hand. With regard to the agreement, he did not think the question of obsolete plant would present a difficulty. The Telephone Co. had greatly improved their plant of recent years, and, he thought, would still further improve it.

In answer to Mr. Keir Hardie, Witness said his estimate of 13½ millions provided for 400,000 filled lines and duct spaces for 200,000 more. He had attempted to form no estimate of the value of the plant of the company in 1911. Personally, he was in favour of buying the company's system rather than laying down a duplicate system.

Answering questions by members of the Committee, Witness said that the Postmaster-General had expended a total of 2½ million sterling in round figures on trunk main for the service over the whole of the country. He thought that in 1911 the number of subscribers would have become so large that the State would have to take over both the systems of the company and the systems of the municipalities. He did not think it would be possible to give any preference. The cost of working on the flat rate system was far more than if proportionate charges were made. The large user got the benefit and the small one was penalised.

The Committee adjourned.

The Administrative Power Scheme.

Tuesday, June 6th.

In the House of Lords this Bill came up for third reading, and its postponement was asked for by Lord Kinnaird, his contention being that the Bill involved a reversal of Parliamentary policy regarding electrical undertakings.

His Lordship was followed by the Earl of Onslow, who failed to see what object could be served by the postponement, the Bill having been carefully gone into by the Committee.

Earl Cawdor said that six weeks had been devoted to consideration of the matter, and the existing companies had been protected by a special clause.

It was, however, stated by Lord Kinnaird that the companies were not satisfied with the clause, and he hoped that protective amendments would be inserted.

Lord Avebury also referred to the disadvantages under which the existing companies were placed.

The Bill then passed its third reading.

Wellingborough and District Tramroads and Electricity Supply Bill.

This Bill came before Lord Brougham and Vaux Committee of the House of Lords on May 25th and in the early days of last week.

The case for the promoters was opened by Mr. Moon, K.C., who stated that the Bill was to empower the British Electric Traction Co., to construct new tramways in the County of Northampton, and also to erect two generating stations, and to supply electricity in certain parts of the counties of Northampton, Bedfordshire and Huntingdonshire. It was also proposed to abandon certain portions of tramways already authorised. The tramways proposed to be constructed were two very short lengths. In regard to the proposal to supply electricity, that company merely proposed to take the ordinary powers of an electric power supply company. It was proposed to put up a power station at Wellingborough with a capacity of 3,000 kw., and they were taking power to supply within their proposed area to any company or local authority, and also direct to manufacturers. There were a great many small manufacturers in the district who could not economically use large engines. The company would, of course, supply their own tramways.

Mr. Evan Alfred Evans, engineer to the promoting company, explained that one reason why a certain portion of the line was to be abandoned, was that it would have involved the construction of an expensive viaduct over the River Nen.

Mr. S. Z. de Ferranti was then called, and gave evidence as to the proposal to supply electricity in bulk. The company could not afford to generate a supply if they had not their own tramways to take a part of it. He believed that there were 200 boot factories within the area proposed to be supplied. They calculated on supplying 725,000 units yearly to their tramways. The average price would work out at 1·64d.

A large number of local witnesses were called, and also Mr. Madgen, of the British Electric Traction Co., who supported the estimates of Mr. Ferranti.

In cross-examination by Mr. Cleasе (who represented the Northamptonshire County Council), Witness agreed to compile a detailed list of the powers granted at different dates to the British Electric Traction Co., showing what had been done in the way of construction and what works had not been commenced. He maintained that it was not the practice of the British Electric Traction Co. to allow the powers they obtained from Parliament to lie dormant.

At a later stage Mr. Madgen put in the detailed statement as promised.

Mr. Ram (for the Northamptonshire County Council) said he had made investigations concerning the return which had been put in by Mr. Madgen. This statement showed that, with two exceptions, all the powers obtained by the company had been put into operation, and that the works were under construction. He had dispatched a number of telegrams to the town clerks of the towns concerned, and the replies were greatly at variance with Mr. Madgen's statement. The replies showed that, in many cases, the works had not been constructed; in some the works had been commenced, but were abandoned; while in other cases the powers had been sold. He contended, in the face of these replies, that the list was quite untrustworthy.

Mr. Moon, K.C., for the promoters, said he must certainly object to these telegrams being taken as evidence.

Mr. Sydney Morse, solicitor, was called by Mr. Moon, and gave a denial to the statements in the telegrams. He said that in the cases where work had not actually been commenced the plans were prepared.

Mr. Cleasе addressed the Committee for the Northamptonshire County Council, and said that the company had already had power for five years to construct tramways. The electric power supply part of the Bill was, he submitted, a hopeless one if the maximum prices were enforced. The population in the area was about one person to the acre, and under the circumstances prevailing in the district the clauses regulating the conditions of supply were extraordinary. He contended that the company had prevented the supply of electricity in the district, and only this year had prevented a lighting order for the districts of Rushden and Higher Ferrers on the ground that there was no demand for electricity. The County Council wished to prevent that in the future, and asked the Committee to reject the Bill, for he did not believe they intended to carry out the powers contained in it.

Mr. Moon expressed indignation at the attitude adopted by the opponents to the Bill. The circumstances which had prevented the construction of the tramways had been explained to the Committee. If the application for an extension of time was not granted, no one else would carry out the scheme, and the district would have to wait many years. He was willing that power should be given to the Board of Trade to revoke the company's powers if substantial progress were not made with the Bill within 12 months. With regard to the power supply portion of the Bill, the usual clauses were there.

The Committee deliberated in private, and afterwards it was announced that the preamble was found not proved.

London Southern Tramways Bill.

This Bill came before Mr. Gair Ashton's Select Committee of the House of Commons on May 30th.

The case for the promoters was opened by Mr. Balfour Browne, K.C., who said that the proposal of the Bill was to electrify the existing horse tramways of the company from Norwood to Vauxhall and from Brixton to Camberwell Green, by means of the overhead system of traction. Where the line crossed the Brixton Road, it was proposed to widen that road and the Stockwell Road by rounding off the corner of the north side of the Stockwell Road and the west side of the Brixton Road. Certain alterations in levels would also be necessary where the line passed beneath railway bridges. The company proposed to take land near Knight's Hill for the purpose of a generating station, but an alternative site had been suggested near Herne Hill Station. The company had spent £112,500 on the existing tramways, and it was proposed by the Bill to take powers to spend on new works and electrical equipment a sum of £195,000.

Mr. Wm. Martin Murphy, the chairman of the company, was called, and said that the company would commence the electrification of the tramways as soon as they got their powers. They had not electrified their line, because they anticipated being bought out by the London County Council. The company would agree that the conduit system should be adopted for that portion of the line between the Brixton Road and Vauxhall. The company wished that they should have a term of 40 years before the line became purchasable by the local authority, as an electrically equipped line took some time to pay the promoters. He saw no reason why the line should not be worked as a single line with passing places.

Mr. Sidney Hunt, Mayor of Lambeth, said that the Borough Council were supporting the Bill

On Thursday last week Mr. Freer, the Parliamentary agent for the Bill, made an application to the Chairman of Committees of the House of Commons for the Bill to be recommitted. He said that Mr. Ashton's Committee had rejected the Bill without hearing the whole of the promoters' case, and he submitted that under the circumstances there was a case for referring the Bill to another Committee.

Mr. Lowther remarked that the usual course was for the Bill to be sent back to the same Committee.

Sir Chandos Leigh (speaker's counsel) said that the matter would have to be moved in the House.

Mr. Brown, representing the Parliamentary Agents to the London County Council, said that in all probability the decision of the Committee had arisen from the fact that it was proposed to electrify tramways in streets that were very narrow.

Mr. Freer submitted that the Committee should not have come to a decision without hearing the evidence of the engineer. He meant that they could not have come to a decision on the question

of the narrowness of the streets. It was certainly less dangerous to run electric trams through narrow thoroughfares than it was to run horse trams.

Sir Chandos Leigh said that Mr. Justice Wright once non-suited a plaintiff before hearing evidence, and the Court of Appeal decided that he was wrong.

The Chairman said that the promoters would have to follow the usual rule.

Rathmines and Rathgar Improvement Bill.—The Police and Sanitary Committee of the House of Commons which has considered this Bill has found the preamble proved. By Clause 47 power is given to the local authority to purchase the rights of the National Electric Construction Co. under agreement dated May 17th, 1899, and subsidiary agreements.

South Wales Electric Power Distribution Co.—On May 30th the Unopposed Bill Committee of the House of Lords passed the preamble of this Bill, which transfers and vests in the South Wales Co. the undertaking of the Carmarthenshire Electric Power Co

Birmingham Corporation Bill.—The Unopposed Bill Committee of the House of Lords on May 30th found the preamble of the above Bill proved, which empowers the Corporation, amongst other things, to construct a large number of additional tramways at a cost of £295,530, and to reconstruct tramways and electrically equip them, &c., at a cost of £554,820.

Shropshire and Worcestershire Electric Power Bill.—The Bill came before the Chairman of Ways and Means of the House of Commons on Thursday last week. The measure seeks to authorise the abandonment of portions of the area of supply of the company, and also to extend the area of supply so as to include the boroughs of Lichfield and Tamworth, the Urban Districts of Brownhills and Cannock, and the Rural Districts of Cannock, Lighfield, Seisdon, Tamworth and Walsall. The company also seek power to acquire provisional orders from any local authorities or undertakers, and to make certain alterations in their capital. Evidence having been given by Mr. Addenbroke, the engineer to the promoters, the Bill, which was unopposed, was ordered to proceed.

Workmen's Compensation Bill.—When this Bill, which has passed all its stages in the House of Lords, came on for second reading in the Commons, Mr. Tennant moved an amendment to the effect that no measure to amend the Compensation for Accident (Workmen) Act, 1897, can be considered satisfactory which does not contain provisions for compensation for injury to health. At midnight on Monday the debate stood adjourned.

Tramway Confirmation Orders.—The following petitions have been deposited in the Private Bill Office of the House of Lords in opposition to the confirmation of various orders in the Tramways Orders Confirmation Bills Nos. 1 and 2:—To the Aberavon Order, by the Great Western Railway Co.; to the Leeds Corporation Order, by the Great Northern Railway Co.; to the Pudsey Corporation Order, by the Great Northern Railway Co.; to the Gorton U.D.C. Order, by the National Telephone Co. The National Telephone Co. are also opposing the Colchester Corporation, the King's Norton and Northfield U.D.C, and the Portobello and Musselburgh Orders.

Wimborne and District Electric Lighting Order.—The Dorset County Council have given notice of their intention to oppose this Bill in Electric Lighting Provisional Orders Bill, No 9.

Gravesend Electric Lighting Order.—The South-Eastern and Chatham Railway Co.'s Managing Committee, the Associated Portland Cement Manufacturers, and the Northfleet and Greenhithe Gas Co. are opposing the Gravesend Electric Lighting Order, which provides for an extension to Northfleet.

Second Reading.—In the House of Lords on June 2nd the Great Northern, Piccadilly and Brompton Railway (No. 1) Bill was read a second time.

Third Readings.—In the House of Lords on May 30th, the North Metropolitan Electric Power Supply Bill and Accrington Corporation Bill were read a third time, and passed.

In the House of Lords on June 5th, the Metropolitan Electric Supply Co. (Acton District) Bill and the South Wales Electrical Power Distribution Co. Bill were read a third time and passed.

In the House of Commons on June 5th, the Dublin United Tramways Bill was read a third time.

In the Commons on Tuesday, the London County Council (General Powers) Bill was read a third time.

LEGAL.

British Electric Traction Co., Ltd., and the Bideford, Westward Ho and Appledore Co., *v.* Chadwell.

In the King's Bench Division of the High Court of Justice on Wednesday last week, the action of the British Electric Traction Co., Ltd., and the Bideford, &c., Co., against Mr. Charles Chadwell, of Richmond Chambers, Blackburn, was down for hearing. The action was to recover £8,690 for breach of a contract and £2,000 for loss of profit.

Mr. Llewellyn Davis, who appeared for the plaintiff companies, said the defendant did not appear, either by counsel or in person. The action was brought to recover the sums named, the first item being for money expended by the plaintiff companies in completing a line of light railway near Bideford, North Devon, which the defendant as contractor had, by an agreement dated February 9th, 1900, undertaken to carry out. He had also failed to buy the necessary land for the railway. The agreement provided that in case the defendant wilfully made default in proceeding with the work, which he did, the plaintiffs could complete it, and recover any extra expense incurred by them in so doing from the defendant. The plaintiffs' case was, that the defendant had failed without reasonable cause or excuse to complete the line within the time fixed by the agreement, and that in consequence they had to finish it at a cost of £8,690. They claimed that amount, and also £2,000 for loss of profits which they said they would have made if the opening of the line had not been delayed from April 9th, 1900, until May 18th, 1901. After reading various items making up the claim, counsel said there was no doubt the plaintiffs had full power to remove the defendant in default of his going on with the contract. The defendant had put in a defence in which he said the amount claimed by the plaintiffs was excessive, and he disputed items amounting to £3,666. As to the loss of profits on the line, Mr. Davis said that it had not been worked at a profit yet, but the delay caused by the defendant had further put off the time when it would undoubtedly earn a profit.

Mr. Jas. Thos. Jarvis, consulting engineer to the plaintiff companies under the agreement, gave formal evidence as to the defendant having left the line in an incomplete state, and as to the plaintiff companies having had to finish it. He also gave evidence as to the value of the material left on the ground.

Mr. Gale, resident engineer, said that what was left of the materials when the work was completed was £1,080. The work of completing the line was economically done.

On the case being called on Thursday morning (1st inst.), Mr. Ashton said he had been instructed to appear for the defendant and contest the case, especially on the points of wilful default and the accounts. He was prepared to go on, and asked for a short adjournment.

His Lordship adjourned further hearing until Friday.

Edler *v.* Adams Bros.

(Guaranteeing an Electric Motor.)

In the City of London Court, on Friday, before his Honour Judge Lumley Smith, K.C., an action was brought by Mr. Arno Edler, 17, Appold Street, Finsbury, to recover the sum of £94 11s. against the defendants, Messrs. Adams Bros., 59, Moor Lane, for an electric motor supplied to their order.

Mr. R. J. Colam, plaintiff's counsel, said the defendants had until July last year driven their machinery by a large gas engine. They had had an electric motor for auxiliary purposes, but just prior to July 15th they had an interview with the plaintiff who was asked to supply a small motor of 2½ H.P., which the defendants said they wanted to enable them to work their machinery overtime. The plaintiff suggested that the defendants should have a separate motor for each separate machine, as the transmission of power through the shafting and belting caused so much waste before reaching the machines. The defendants said they could not afford that, and then the plaintiff suggested that the defendants should have two motors, one for each floor. Ultimately a motor was supplied, and the question the Court would have to decide was whether there was an implied condition that it was fit for some specific purpose which the defendants mentioned to the plaintiff. Their case was that the motor would do all they had promised.

Mr. Gover, for the defendants, said they told the plaintiff the purpose for which the motor was required, and it was absolutely useless. Mr. Colam said the whole question turned upon whether the voltage was strong enough to drive the defendants' machines. The plaintiff said that the defendants stated that they wanted a 15-H P. motor, but when the defendants got the motor fixed up they put so much strain upon it that when it was worked up to 25 H.P. it blew the fuses. The defendants had expert advice as to whether the machines would be suitable or not for their purpose. It was not true that the plaintiff had ever said that a 15-H.P. motor would be sufficient to drive the whole of the defendants' machinery. It was only supposed that they would use it for one or two machines at a time and not for the whole eight.

For the defence, Mr. Adams said the motor for which the plaintiff was suing was quite useless for the purpose for which they required it. They expected a motor to drive the machines in the basement, and if they did not want to run the basement then they expected the motor to be able to drive the next floor or the second floor. As a matter of fact, the motor would not turn the shafting round. It was not the slighest use in the world.

Judge Lumley Smith, in giving judgement, said it was true the motor had been fixed on the first floor because the defendants requested it. The defendants set up that there was a guarantee that the motor would drive all their machinery or that it would do certain work. The defendants further relied upon Section 14 of the Sale of Goods Act. It was not made out to his satisfaction that the buyers had relied upon the seller's skill or judgement. He thought there was a general talk about what would be best to be done, and he thought Mr. Adams had very considerable experience in machinery, because he had a gas engine and a 2½-H.P. motor, and he came to the conclusion that the electric motor of 15 H.P. was what he wanted. He did not want it for all the machinery but only for emergency, and the defendants knew best what sort of emergency was likely to arise. He did not think there was any guarantee by the plaintiff that the motor should do any particular

work, and he did not think it could be inferred from the matter. On the whole, judgement must be given for the plaintiff on the claim for £94 11s. as well as on the counterclaim, with costs.

WESTMINSTER ENGINEERING CO. *v.* ACCUMULATOR INDUSTRIES, LTD.

THIS case came before Mr. Justice Bray on Friday last in the King's Bench Division for argument on a point of law stated in the form of a special case by Mr. Verey, the Official Referee.

It appeared that the defendants are the owners of a system of train lighting, and the sole question was whether under an agreement of September 12th, 1904, the Accumulator Industries Co. were entitled to have delivered by the Engineering Co. 24 No. 4, and 24 No. 5 railway dynamos of 30 amperes and 40 amperes respectively, and inasmuch as the dynamos which had been delivered were found by the arbitrator to be of an increased output, whether the Accumulator Industries Co. were entitled to reject them. The arbitrator found as a fact that after the original order was given by the Accumulator Industries Co. to the Engineering Co. in March, 1903, the further instructions given by the former company to the latter involved an increased output.

After hearing Mr. A. J. WALTER on behalf of the Accumulator Industries Co., and without calling upon Mr. Norman Craig on behalf of the Engineering Co., his Lordship came to the conclusion on the construction of the contract that all the Engineering Co. had agreed to do was to make certain modifications and alterations in existing machines specified in the original contract, and that there no longer remained any warranty, or any condition, that the dynamos should have an output of 30 or 40 amperes, and no more, except so far as it might have been caused by the specified alterations and modifications. He, therefore, decided the point in favour of the Engineering Co., the costs of the argument to follow the event.

Mr. CRAIG said that in those circumstances the award of the arbitrator would stand as stated in paragraph 7 of the award.

His LORDSHIP agreed.

WORKMEN'S COMPENSATION ACT.

AN interesting decision under this Act was given by Judge Tindal Atkinson at the Edmonton County Court on Monday. According to the *Daily Telegraph*, the applicant, an engineer, was injured while going up a lift which he was engaged in repairing at some mansions at Baker Street, W. It was contended that the work came within the words of the statute, which defined that engineering work "includes any other work for the construction, alteration, or repair of which machinery driven by steam, water, or other mechanical power is used." It was argued for the respondents, Messrs. Johnson & Smith, engineers, of Stoke Newington, that the lift in this instance was not machinery used in the course of repair. It was the machinery itself that was being repaired. His Honour gave judgement for the respondents.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Losses in Armature Teeth.

With reference to Mr. Catterson-Smith's curves, fig. 5, in his paper on "Commutation" read before the Institution, and also the letter of Dr. Pohl *re* short-circuit currents, I should like to draw attention to a further important cause of increased losses, which is the distortion of the magnetic distribution curve *per se*, affecting the eddy-current losses in the armature teeth. The matter of distortion was discussed in a paper on "Iron Loss" published in the *Electrician* for October 16th, 1903. Such curves as fig. 5 would appear to the writer as an excellent corroboration of the theory outlined therein.

A. Press.

New York, U.S.A., *May 22nd*, 1905.

The Bayliss Grip Socket Patent.

A misleading report having appeared in the Birmingham papers with reference to the proceedings for the revocation of the patent known as the Bayliss grip socket, brought by our clients, the Simplex Steel Conduit Co., Ltd., against the Metallic Seamless Tube Co., Ltd., to whom this patent had been assigned, to prevent any injury that may be incurred by our clients therefrom in the electrical trade, we shall be glad if we may be permitted to make known the true facts of the case in the interests of our clients and of the public.

A short time ago the Metallic Seamless Tube Co., Ltd., threatened legal proceedings against our clients for an alleged infringement of this patent. These threats naturally interfered with our clients' business, and no steps whatever were taken by the Metallic Co. to follow them up with their threatened action. The Simplex Steel Conduit Co., Ltd., therefore, placed the matter in our hands, and our experts and counsel having been consulted, we were advised that beyond the shadow of a doubt this patent could be revoked, which would remove some uncertainty in the electrical trade and make impossible for the future such threats as those to which our clients have been subjected. We, therefore, obtained the authority of the Attorney-General for the presentation of a petition, and the petition came on before Mr. Justice Joyce on Saturday last, the 3rd inst., when the Metallic Co. submitted to the revocation, and judgement was given in favour of the Simplex Steel Conduit Co., Ltd., with costs in the usual way. Previous to the hearing, we had received a letter on May 9th from the Metallic Co.'s solicitors, that they would not contest the petition, but would agree to the revocation asked for. We may state that Mr. J. C. Graham was counsel to the Metallic Co., while we were represented by Mr. A. J. Walter.

Glynne, Jones & Co.

1, Staple Inn, Holborn, W.C.
June 7th, 1905.

Power Station Economies.

I notice that Mr. J. A. Jeckell evades the point raised in my previous letter under the plea "that he does not take cognizance of anonymous communications." However, it is quite unnecessary to enter into a long discussion.

My object in writing was not in any way to disparage the results obtained by the Coventry staff, but to express disapproval—which I am sure the majority of your readers endorse—of this case of self-glorification at the expense of others.

A man has a perfect right, if he has done anything praiseworthy, to publish that fact, but at the same time it is always well to remember the old adage "Good wine needs no bush."

I beg to still subscribe myself

Station Engineer.

Terms as between Electrical Manufacturers and Electrical Contractors.

As it is evident, from information received, that a misunderstanding exists as to the terms upon which electrical manufacturers should supply their goods to members of the Contractors' Association, my committee are desirous that it should be generally known that the preferential discount of 2½ per cent., as provided under the original agreement between the Electrical Manufacturers' and the Electrical Contractors' Associations, ceased with the termination of the agreement, and should in no way be taken into account as from January 1st last.

W. Davenport,
Secretary, National Electrical Manufacturers' Association.

London, S.E., *June 5th*, 1905.

The Mobus.

The most striking novelty in the County of London at this moment is undoubtedly the motor-omnibus.

The palpable success which it has achieved (after several dismal failures) has not only raised many discussions as to its power of competition with electric trams, but has given birth to several prospectuses of motor-omnibus companies.

I have, of course, watched the motor-omnibus with a critical eye. I am pleased to see that it "gees," and I should like to learn that it pays.

On three occasions I have succeeded in getting on board one of these highflyers, and if I had not been a bit of an acrobat I might still have been on board.

As at present managed, the motor-omnibus is merely a demonstration. It travels twice as fast as the horse traffic,

and therefore has to take the middle of the road; it consequently fails to pick up passengers.

The good old London omnibus owes its success to the fact that it dribbles along the edge of the pavement, and picks up every man, woman and child that would prefer to ride rather than walk.

If the power omnibus is to be tested as a money earner, then it must follow the same procedure, and devote itself to picking up passengers in preference to swishing through the air at 10 or 12 miles an hour. Some day, when the horse will no longer be seen in the City, the pace may be improved, for it will be possible for the police to fix stopping places applicable to all omnibuses passing through the several streets. Even at the present time there is a good opening for an express service morning and evening on the suburban roads.

It is scarcely necessary to point out (except to the uninitiated) that the expense of maintenance rises probably as the square of the speed, but what that expense will amount to per mile no one knows. A maker of these vehicles told me last week that a set of four wheels complete with tires costs £180, and a few days later, I saw an omnibus slide twice its own length with its wheels locked—india-rubber makes a very good roller, but a very poor skate—consequently the life of india-rubber tires, when treated as above, will be very short.

I know that rubber tires are being supplied under maintenance contracts of about 2d. per mile, but such contracts are likely to prove entirely delusive, unless the actual cost of maintenance should come out less than the contract price. I do not suppose for a moment that a tire guarantee would hold good if it were proved that the tires were used as skates.

I am not a pessimist in motors; on the contrary, I look forward to an early extinction of the horse in cities, but the motor-omnibus appears to me to be working for theatrical effect rather than for practical commercial result.

In the horse omnibus, the driver acts as tout or commercial agent; if you stand on the curbstone anywhere in the Strand for 30 seconds with an air of indecision, you will be hailed by half a dozen drivers, but the motor-driver has no time to hail passengers—what with his steering gear, clutch gear, sparking plug and carburetter, his time is fully occupied.

He fixes his mind on driving, and the conductor in the rear is too much in the rear to catch the anxious expression on the countenance of the "would-be" passenger.

A week or two ago I came out of Waterloo Station, and finding a motor-omnibus at the foot of the incline, boarded it. The driver was an elegant young man, such as any parlourmaid might be proud of; he was ornamented with a bunch of primroses and a cigarette; he drove us (or me, for there were no other passengers) like Jehu the son of Nimshi.

At the corner of Westminster Bridge we picked up three more passengers, and then we flew up Whitehall to Piccadilly Circus—I never rode behind a better driver—he took flies off the wheels of passing cabs; in fact, he was a first-class sportsman, but he collected no passengers—I could not refrain from saying (to myself) "this is magnificent, but it is not business."

The corollary is that the successful motor-omnibus must accommodate itself to the normal speed of the traffic, and the conductor must be stationed in front, where he can catch the eye of the expectant passenger.

John S. Raworth.

London, S.W., *June 5th*, 1905.

Gas Engine Working.

Under the above head a correspondent writes asking for results of the working and experience of persons in charge of a Westinghouse gas engine (using town's gas) of 100 B.H.P. Why the Westinghouse in particular?

It has been my lot to be connected with several large gas-driven plants, all of different makes of engines, and I have found the Westinghouse to be as good as any other make, so that I should prefer to discuss gas-driven plants in general, and not aim at the Westinghouse engine as being the cause of all our troubles and anxieties.

My experience of gas engines extends over a period of many years, and is quite in accordance with that of others whom I know to have had the superintendence of gas engines. When first in charge of this type of engine I was full of energy, full of zeal, and if what my friends said was true, full of capacity; at any rate, I had had much experience in the building of engines, and was the happy possessor of a large share of that particular attribute, for which the patriarch Job was so famous. I was then fully persuaded that the steam engines in use at electricity supply stations would soon have to be scrapped to make room for gas sets, that large mill engines were tottering on their foundations, and that gas engines, and only gas engines, would reign supreme.

At the present moment the din of the gas engine is ringing in my ears, but my opinions are changed. I have broken faith with my patience, and, like the above illustrious person, I have cursed the day on which I was born, and now sincerely believe that the gas engine will be scrapped first.

The chief cause of complaint against the gas engine, is its unreliability and uncertainty of action; occasionally, without any apparent reason, it becomes as stupid as the proverbial ass, and refuses to respond to the efforts of the man-in-charge to start it—until the critical moment has passed, when it will go off as bravely as possible. At other times it will start up all right and run for two or three hours, when it will suddenly begin to bang and crack as if artillery practice were going on in the place. Several times I have appealed to the makers for advice respecting these defects, but they invariably reply that the fault lies in the inability of the staff under my charge, and not in the engine; such a statement I stoutly resent, knowing my men too well to be misled by such a tale.

Then the quality of the gas is said to be at fault, and after taking a few calorimeter readings, and finding the quality down a little, a complaint is made to the gas manager, who replies that my testing instrument must be wrong, as he finds the gas to be all right, and concludes by advising me to have the engine put right, something which I have been trying to do for a considerable time.

With regard to the working of the engines, as to fuel costs, &c., all I can say is that there are several steam-driven stations of a similar output that beat us hollow.

Gas engines will be more successful when their makers make them more reliable, respect the wishes and ideas of men in charge, and do not adhere so tenaciously to the laws of the Medes and Persians.

Magneto.

Indication of Leakage and the Home Office Rules.

In the correspondence relating to this subject lately published in your columns, personal feeling seems to have completely obscured the points at issue. It seems, therefore, desirable to state clearly what can and what cannot be done in the direction of complying with the Rules, in order that those less familiar than are instrument makers with the electrical principles involved may not be misled.

There is no need for any affectation of mystery in the matter. All the methods at present in use are based on well-known principles, and are common property.

1. *Leakage Current.*—It is laid down in the Rules that the leakage current shall not exceed $\frac{1}{1000}$th of the full load current. Unless the circuit be earthed at some accessible point, the leakage current cannot be measured; for no instrument can indicate whether a current going out along the line is going through motors, or directly to the other main. The leakage current can only be derived, somewhat laboriously, from a measurement of the insulation on both mains, and a calculation: it cannot be measured in an insulated circuit. (I am assuming that "leakage current" is current passing, at some part of its circuit, through the earth.)

2. *Indication of Insulation.*—All methods of indicating insulation in an unearthed circuit depend on the measurement of the P.D. between main and earth. Therefore, all depend on the E.M.F. applied to the circuit, and their scales, if they profess to have them, *are only correct at one voltage.*

Methods like that of paragraph 4 below, which depend on the difference between the P.D.'s between earth and main, are independent of the E.M.F. of supply; but they give no accurate means of determining the insulation resistances.

3. The commonest method is to connect a voltmeter between one main and earth, in which case its indication depends (in an indirect manner) on the value of the resistance to earth of the other main (fig. 1). Any leak on the main to which it is coupled, however, alters the scale reading—so that no scale of ohms can be correct at all times, but the insulation of both mains may be found *by calculation* from the readings taken with the instrument coupled first to the + and then to the − main.

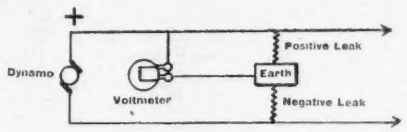


FIG. 1.

4. It will be noted that the arrangement of paragraph 3 gives no continuous indication for both mains, but a simple modification of the connections provides this:—Let two equal resistances R_1 R_2 be coupled at one end to the two mains, and at the other joined together and to the indicating instrument, whose second terminal is put to earth. Then any *inequality* in the P.D.'s between the two mains and earth causes a deflection.

With this scheme of connection there may exist *equal* leaks of large amount on both mains, without any deflection being observed; therefore, the arrangement does no more than serve as an alarm in case of an accidental leak on one main only.

5. If means be provided for interrupting the circuit of either of the resistances, the instrument remains coupled between one main and earth (fig. 2); and the two readings obtained by breaking each resistance in succession give values from which the two leaks may be derived—from a table or curve, *not* by a simple indication.

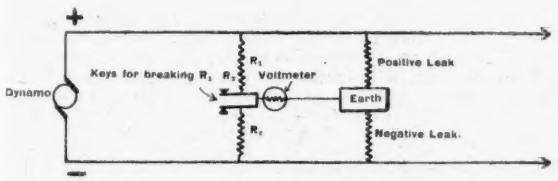


FIG. 2.

The Home Office fully recognises that such a system comes as near as is practicable to fulfilling the requirements of the rules, and is satisfied with it "till better means can be devised."

6. The above scheme is drawn for a two-wire system, and serves either for direct or alternating current. A similar arrangement can be adopted for three-phase circuits, as indicated in the following sketch:—

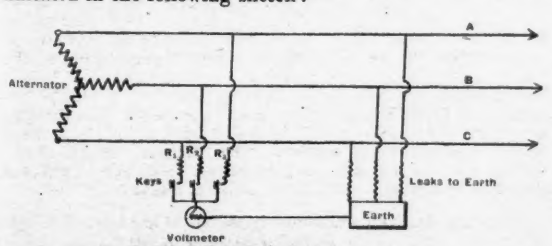


FIG. 3.

To sum up:—In insulated circuits—

1. The leakage current cannot be measured.

2. The values of the resistances of both [or all] mains cannot be continuously and directly indicated.

3. The values of the said resistances can be deduced from two [or three] observations, either of which is useless without the other [or others].

These propositions are incompatible with the letter of the requirements of the rules, and to dismiss them airily as "in accordance with their spirit," seems to be undesirable in view of the penalties attaching to the position of a colliery manager who neglects to obey the law. The proper course pending the reconcilement of the rule with the physical possibilities, appears to be for the instrument maker to obtain Home Office sanction for the method he proposes, and for the colliery to try no instrument which has not been approved.

The form which an instrument maker should adopt in advertising the methods he prefers to use must be left to his own conscience—but some recent examples seem to be characterised by a certain economy of truth.

E. B. Vignoles.

London, W., *June 6th*, 1905.

Mr. C. D. FALCKE informs us that the word "guarantee" in the last paragraph of his letter on "Charging for Supply," published in our last issue, was due to a shorthand error; the word intended was "grant."

ADDRESS WANTED.—Will Mr. R. Stanley Smith kindly send his present address to the Editors?

THE PROPOSED SOUTH MANCHESTER ELECTRIC RAILWAY.

THE main features of the South Manchester Electric Railway scheme, which was briefly referred to in our columns last week, were explained at a meeting held at the Midland Hotel, Manchester, on Tuesday last, of residents and others interested in the district through which it is intended the line shall run. The meeting was presided over by Mr. E. Halliday (Messrs. Halliday, Pearson & Co., accountants), and there were present some 20 or 30 gentlemen. The joint engineers of the scheme (Mr. John M. Newton, of Manchester and Westminster, and Mr. James M. Welch, of Manchester) attended to explain the details of the scheme. According to a key map which was exhibited, the line will start near Whitworth Park, in the City of Manchester, and, passing Barlow Moor, will cross the River Mersey by an iron bridge, continuing by way of Baguley and Davenport Green to Ringway. Bearing eastward, it will run through Styal and Handforth, and continue by Pownall Green and Bramhall Green to Hazel Grove, where it will join the electric tramway system of the Stockport Corporation. There will be short branches from Davenport Green to Hale Carr, from Barlow Moor to Chorlton-cum-Hardy, and from Bramhall to Davenport.

Mr. Newton, after describing the route, said probably the whole of the main line would be double. The site for a generating station had not yet been settled, but it might possibly be that a portion of the current for working the traffic would be taken from the Manchester Corporation, and another portion from Stockport. The total length of the main line would be 16 miles—that was from Whitworth Park to Hazel Grove—and, with the branches, there would be a total length to be laid of 20½ miles. The main feature of the line was that it passed through an attractive district within a radius of nine miles from the Manchester Town Hall. The most southern limit of the existing tramways was at Hazel Grove; there was none other, except the Stockport and Gatley line; but there were the lines authorised, but not yet constructed, under the powers of the Manchester Southern Tramways Act, to Northenden (connecting with Palatine Road), and to Sale, where a connection would be formed with the Manchester and Altrincham extension. This new project was well removed from any authorised or existing tramways. There was the further advantage that none of the roads through which their line would pass were main roads—they were all country lanes—so that there was no reasonable prospect of tramway or motor-'bus competition. The promoters did not consider that they were competing with any existing tramway; on the contrary, the line would be a feeder to some. Possibly the Manchester South Junction and Altrincham Co. might regard them as competitors, but as that line already had about as much traffic as it could accommodate, and was not approached within two miles, it could hardly do so with justice. Some comment might be made on the Manchester terminus being so far from the centre of the city (1½ miles), but, with such an excellent tram service as that of Manchester, that would be no great disadvantage. They could not go further into the city, except at huge expense, and they did not feel justified in making that a part of their scheme. On the other hand, the scheme would lend itself to any further extension towards the city that might be desired. There were several ways of doing it. If necessary they could lead off with a "tube," about half a mile back from Whitworth Park Station, and bring the line, say, into Albert Square, with a connection to Victoria Station. But that was no part of their present scheme. The promoters expected to attract a considerable amount of traffic from other lines, at points where those lines intersected their own. It could hardly be used as an argument

against them that they were going through a sparsely populated district. It was obvious that, if there were a series of towns on the route, there must be a railway; what they expected was that a string of villages and residential suburbs would spring up, which would yield a very considerable traffic to their line. He did not anticipate much opposition from the local authorities on the ground that the line would be carried over country roads on the level. His engineering colleague and himself were strongly of opinion that the convenience of the public would be better served by level crossings, over unfrequented roads, than by bridges. At each crossing there would be a stopping place for setting down and taking up passengers. Locomotion would be much more rapid than by any other form of traction. There was to be no third rail arrangement. Overhead equipment was intended, similar to that in use on the Manchester tramways, with such modifications in detail as might be considered necessary. In the improbable event of new country roads being constructed capable of being used by tramways or motor-omnibuses, neither kind of conveyance could possibly compete with them in the matter of speed.

Some discussion followed, in which a general approval of the undertaking was expressed by several gentlemen.

Mr. Boutflower held strongly that the section of the line nearest Manchester would be most useful and profitable. He asked the promoters to consider the possibility of a connection with the Ship Canal Docks, with a view to goods transit.

Mr. Newton said they had not lost sight of the latter advantage, but the present scheme was, in their judgement, sufficient for one Bill. The line would be so laid out as to facilitate a possible connection with the Docks, and the development of an area, on the lines of Trafford Park.

Replying to further questions, Mr. Newton said they estimated that a capital would be needed of £400,000 or £500,000, on the assumption that level crossings would be permitted. If they were compelled to construct bridges, to carry the line either under or above the roads, there would need to be, roughly speaking, another £100,000, in which case it was open to question whether the scheme could be carried through. There would be the further objection to bridges and cuttings on embankments, as the case might be, would depreciate the district for residential purposes.

Objection to level crossings was expressed by Mr. Owen, a gentleman residing at Hale, who in other respects warmly supported the scheme. He hoped the level crossings would not be made a *sine qua non*.

Mr. Newton said that, as engineers, they did not object to another £100,000 being spent, but it was a question whether the increase of capital, necessitated by bridges and embankments, would enable the line to pay such a dividend in the near future as would induce London capitalists to subscribe to it. The level crossings on their line would be less of a nuisance than the numberless crossings of the tram lines in the streets of Manchester. The cars, Mr. Newton added, would be single-deckers, similar to those on the London Underground—not tramcars in any sense of the word.

Ultimately a resolution was put from the chair, and unanimously carried, expressing a general approval of the scheme as submitted to the meeting. Several gentlemen present agreed to serve on a provisional committee for furthering the scheme.

BUSINESS NOTES.

Engine Contracts.—Messrs. Alley & Maclellan, Ltd., have recently booked the following contracts for high-speed engines, practically all of which are for electrical work:—

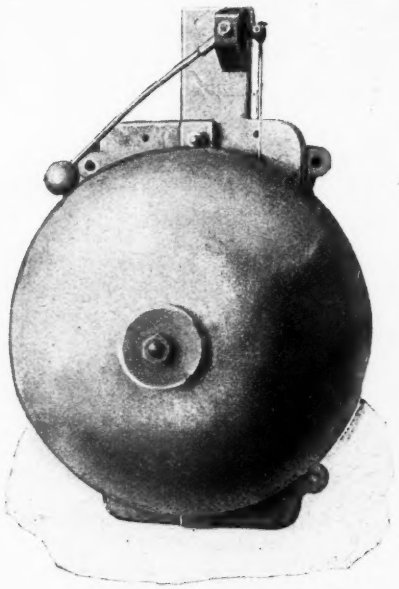
Two engines of 300 H.P. each for Messrs. J. Palmer, Jun., & Co., London, for the Chinese Government, Pekin.
Three engines of 300 H.P. each and two of 60 H.P. each to the order of the British Westinghouse Co. for the Pyle and Blaina Works, Ltd., South Wales.
One engine of 400 H.P. for the Mansfield Corporation (through Messrs. Thomas Parker, Ltd.)
One engine of 100 H.P. for Messrs. Siemens Bros. & Co., Ltd.
One engine of 60 H.P. for the Howe Electrical Engineering Co., Ltd., Liverpool.
One engine of 60 B.H.P. for Messrs. Keep Bros., Birmingham.
One engine of 60 B.H.P. for Messrs. Joseph Kirkham & Co., Kiev.
One engine of 35 H.P. for Mr. James Barclay, Glasgow.
One engine of 40 H.P. for Mr. E. Dewhurst, Preston.

Mechanical Stokers.—We understand that a large firm of steam-users in Lancashire, who have been users of Proctor's mechanical stokers for over 22 years, applied one of the same makers' latest and most improved shovel stokers with moving fire bars about 12 months ago. After carefully testing the same, they gave Messrs. James Proctor, Ltd., of Burnley, an order to fit up 12 furnaces, and after an extended experience with these machines, they have now placed a further order with them for 80 more to be fitted.

Pulford Bros., Ltd.—The seventh annual meeting was held at Liverpool on Wednesday, 31st ult. Mr. E. G. Pulford was elected chairman, and reported that the year's trading had been most successful. They had completed some large contracts during the past year, and had commenced the new year with a considerable amount of work, and the prospects of the company were of the brightest. It was proposed by Mr. J. Cargill, and carried unanimously, that a dividend of 20 per cent., free of income-tax, be paid for the year ended March 31st last, and that the balance of profit be carried to reserve fund, raising this fund to 20 per cent. of the capital. Mr. Theo. S. Sheard was unanimously re-elected auditor for the ensuing year.

Edwards Air Pumps.—We understand that the Edwards pump has recently been adopted for condensing plants at the following electrical stations:—Aberdeen (repeat order); Belfast Trams (three sets of three-throw pumps); Bolton; Calcutta; Colchester; Crewe; Fulham; Gloucester; Hammersmith (two sets of three-throw pumps for turbine plant); Hastings; King's Lynn; Leeds (two sets of three-throw pumps); Malta Dockyard (four sets of two-throw pumps); Norwich (turbine plant); Port Elizabeth (two sets of three-throw pumps); Sheerness Dockyard (three sets of two-throw pumps); South Shields; Tokio; and Woking.

Large Railway Bell.—The accompanying illustration shows one of the most powerful electric bells ever made. The gong is 19½ in. in diameter, and weighs 90 lb.; the weight of the complete bell is about 1½ cwt. The heavy iron clapper, 2 in. in diameter, is of sufficient size and weight to produce loud clear



LARGE BELL, WITHOUT THE HOOD.

notes, the number of strokes per minute being about 100—120. The motion parts are entirely enclosed in a water-tight cast-iron box, the pull rod for actuating the clapper coming through a packed gland. The current required to operate this bell is ¾ ampere at 18 volts, and can be furnished by 12 ordinary size dry cells. The bell is shown without the hood, which normally covers the clapper. It was made under Macleod & Plato's patents, by MESSRS. FULLER, MACLEOD & CO., LTD., of Norfolk House, Laurence Pountney Hill, E.C., primarily for railway working, but, of course, it is applicable to many other purposes.

Brush Contracts.—The following contracts have been booked by the BRUSH ELECTRICAL ENGINEERING CO:—

One 150-KW. motor-generator set, and one 50-KW. ditto, for the Belfast Corporation.
Twelve car-bodies and standard trucks, for the Dundee and Broughty Ferry Tramways, per B.T.H. Co.
Ten motor-omnibus bodies, for the London Motor-Omnibus Co.
Four double-deck four-wheel car-bodies, for the Musselburgh Tramways, per B.T.H. Co.
Twelve double-deck four-wheel car-bodies with standard trucks and Brush motor equipments, for the Provincial Tramways Co., for Gosport and Fareham trams.

Large Electrical Motor-Cars.—The ELECTRIC VEHICLE CO., of Hartford, Conn, U.S.A., has lately completed for the American Sight-Seeing Co., of New York, three large "Seeing New York" electric cars. Each of the vehicles has accommodation for 48 passengers, the seats, which are arranged char-a-banc fashion, being gradually elevated from the front towards the rear, so that the occupants all have a clear view forward. Power is furnished by a battery of 44 Exide cells slung below the body. The vehicle is propelled by two electric motors, each driving one of the rear road wheels through chain gearing. The vehicles, which have a maximum speed of 8 miles per hour, have a wheel base of 9 ft. 4 in., the 36-in. road wheels being shod with 7-in. solid rubber tires.

Heating Lamps.—Referring to the note in our last issue under this heading, the DOWSING RADIANT HEAT CO., LTD., write to point out that, while it is true that they have used a certain number of Sunbeam lamps, from the wording of the notice it would appear that they have used *solely* Sunbeam lamps. This is not the case, as these have formed only a very small proportion of the total number of lamps employed. They have been used chiefly for special purposes, but, owing to the introduction of improvements, the use of this type of lamp has now been practically discontinued.

Belgium.—LA SOCIETE DES ATELIERS DE CONSTRUCTIONS ELECTRIQUES DE CHARLEROI reports a profit of £6,244 for the last financial year.

Reconstruction.—On Monday, in the Chancery Court of Lancashire, at Liverpool, a petition was heard by Mr. F. W. Taylor, as Deputy Vice-Chancellor, which was supported by Mr. Roger Lawrence, on behalf of Fawcett, Preston & Co., Ltd., an old engineering company of Liverpool, for sanction to reconstruct the company. An order authorising the reconstruction was granted.

"Freezor" Electric Fans.—The General Electric Co., Ltd., of Queen Victoria Street, E.C., are distributing to the trade a new electric fan list, which was issued simultaneously with the arrival of the first real warm weather in London this season. The latest patterns, here illustrated, combine in one unit the three styles known as desk, trunnion and bracket fans. They may be adjusted to propel the air in any direction, and require neither extra parts nor special tools to adapt them for use as desk or bracket fans. These fans embody all the good points of the well-known "Freezor" fans, and are an improvement in design and appearance. The field cores are cast integral with the frame, giving an unbroken magnetic circuit, the armatures are wound with double silk insulated wire, and the commutators are made of hard drawn copper, insulated with mica. The brush-holders are of the cartridge type, and each one of the brushes—which are square in section, to ensure large and continuous contact with the commutator—may be easily removed by the withdrawal of a pin. The regulators, which give three speeds, are made of mica plates wound with high-grade resistance wire, of ample capacity to carry the maximum current without undue heating. The plates carrying the wires are separate units, and are combined in proper numbers to give the requisite resistances for the different sizes and voltages of fans. To change from desk to bracket, or *vice versâ*, is a very simple operation. The horizontal adjustment extends over nearly a full circle, and a friction device holds the fan firmly at any desired point. The body swings on pivots in the trunnion, a set screw being provided to hold it in place at the desired angle. A variety of types of fans are illustrated and priced in this list for ceiling, cabin, desk and bracket use. The last four pages are devoted to alternating-current fans; in this section a special pattern is shown fitted with trunnion frame. It is provided with a switch, but without speed regulator, and the speed varies from 1,150 r.p.m. at 40 cycles up to 1,400 r.p.m. at 60 cycles. Fig. 1 shows a continuous current bracket fan, and fig. 3 an alternating-current ditto; fig. 2 represents a small continuous current fan for ventilating or porthole use.

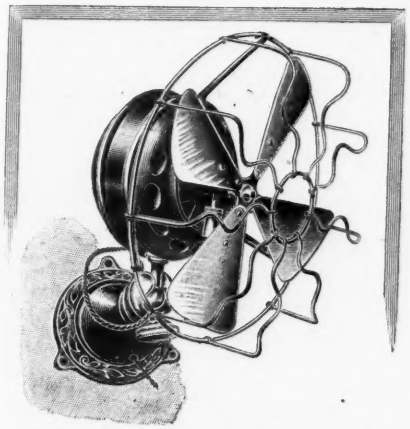


Fig. 1.—"Freezor" d.c. Bracket Fan.

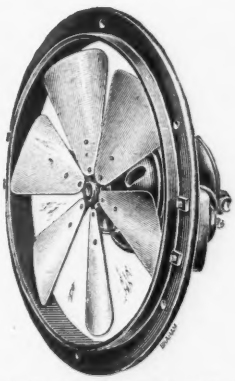


Fig. 2.—Porthole Fan.

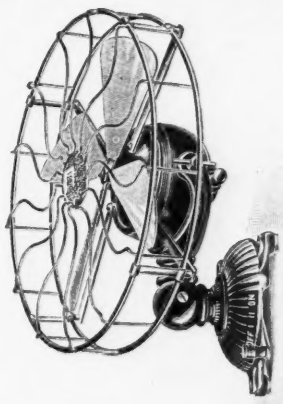


Fig. 3.—"Freezor" a.c. Bracket Fan.

Book Notices.—"Project of Terminal Harbours for the Panama Canal." By Lindon W. Bates. New York: 74, Broadway.

"Le Four Electrique, son Origine, ses Transformations, et ses Applications—Forces Naturelles, Electro-Métallurgie, Chimie par voie Sèche." By Adolphe Minet. Paris: A. Hermann. 4s.

"Modern Electric Practice." By Magnus MacLean. Vol 6. London: The Gresham Publishing Co. 9s. net.

"Journal of the Institution of Electrical Engineers," May, 1905, No. 172, Vol. XXXIV. London: E. and F. N. Spon. 5s.

"The Rudiments of Practical Mathematics." By A. Consterdine and A. Barnes. London: John Murray. 2s. 6d.

"Bulletin of the Imperial Institute." Quarterly, Vol. III., No. 1, 1905. London: Imperial Institute, S.W. 1s.

A book entitled "Modern Lightning Conductors," is to be published shortly by Crosby Lockwood & Son, and will be of interest to all who wish to study the question of protecting buildings against lightning damage. The author, Mr. Killingworth Hedges, C.E. (Hon. Secretary of the Lightning Research Committee, which has just issued its Report), besides illustrating many of the examples of lightning strokes furnished by the committee's observers, is giving details and specifications as to the best methods for carrying out the rules and suggestions contained in the report.

Wanted for Exhibition.—The Newcastle-upon-Tyne Electric Supply Co., and the County of Durham Electrical Power Distribution Co. are increasing their showroom accommodation, and want particulars of electrical apparatus and goods for exhibition therein. See our advertisement pages to-day.

Tredegar Iron and Coal Co., Ltd.—In their annual report the directors say:—"The collieries and works have been maintained in a condition of full efficiency. Two improved screening plants have been completed and a third is being erected, the importance being fully recognised of marketing coal in the best possible condition. The electrical plant, the installation of which was commenced about four years ago, has now been working in its entirety for a sufficient period to enable your directors to state, after very exhaustive tests and minute inquiry and comparisons, that the results fully justify the expenditure in adopting electricity as the motive power for hauling, pumping, and lighting the collieries."

A German Combine.—By resolutions carried at the general meeting held on May 4th, the firm of Felten and Guilleaume Carlswerk Actien-Gesellschaft, of Mülheim-on-Rhine, takes over the manufacturing portion of the firm Electricitäts Actien-Gesellschaft vorm. W. Lahmeyer & Co., of Frankfurt-on-Main, and the style of the new firm is Felten & Guilleaume-Lahmeyer Werke Actien-Gesellschaft. To carry out this arrangement, and at the same time increase the working capital, the Felten and Guilleaume Co.'s capital has been raised from 36,000,000 marks to 55,000,000 marks. The new shares have been issued at 110 per cent., free of charge, and are entitled to dividend for the current year. The management of both concerns remains unchanged. As stated above, it is the manufacturing part of the Lahmeyer Co. that enters into the new combine, whilst the Electricitäts Actien-Gesellschaft vorm. W. Lahmeyer & Co. as a firm still continues to exist, and assumes the character of a finance institution, and will remain in touch with the new Felten & Guilleaume-Lahmeyer Works in so far as they receive, as an equivalent for the surrender of their manufacturing business, a corresponding proportion of the shares of the new company. The transaction was concluded on the basis of the status of the Lahmeyer Works on March 31st. The Electricitäts Actien-Gesellschaft vorm. W. Lahmeyer & Co., in addition to the 17,000,000 marks shares taken over of the new company's shares, retain possession of their investments figuring in the balance-sheet at 8,745,886 marks. Their capital of 20,000,000 marks and obligations of 12,975,000 marks remain unaltered. During the last four years the Lahmeyer Co. paid in dividends 10, 0, 0 and 2½ per cent. respectively. The firm of Felten and Guilleaume, Carlswerk, whose style is changed to Felten and Guilleamme-Lahmeyer-Werke, was converted into a limited company at the beginning of 1900, with a capital of 30,000,000 marks, increased at the end of the same year to 36,000,000 marks. This firm has been the property of the Guilleaume family for more than 75 years. Since the conversion into a limited company, dividends of 10, 0, 5 and 5 per cent. have been declared for the years 1900, 1901, 1902 and 1903 respectively. For the year 1904 a dividend has just been declared of 8 per cent. The shares of the Felten and Guilleaume Co. have hitherto been held exclusively by the Guilleaume family, and we understand this will continue to be the case. The board of directors was hitherto composed of Messrs. Theodor & Max von Guilleaume and Mr. Justizrat Heiliger, all of Cologne. The works of Felten & Guilleaume Carlswerk employ about 5,000 hands, and engines of 5,500 H.P. Their principal manufactures are wires and wire products. In addition the cable factory is one of the most prominent branches, whilst the Lahmeyer Co. has been chiefly engaged in the manufacture of dynamos. It is calculated that the combine will reap considerable benefit from the existing commercial relations of both concerns. The amalgamation is regarded as an event of high significance in connection with German electrical industry, as in future the concern will embrace almost every branch of the vast field of electrical engineering. The Allgemeine Electricitäts-Gesellschaft and the Union Electricitäts-Gesellschaft have been united for some time past, as also the Siemens-Schuckert group. The German electrical industry is, by this latest combine, divided into three important groups. The Felten & Guilleaume-Lahmeyer Works form the third group, in the west of Germany.

Catalogues and Lists.—Alliance Electrical Co., Ltd., Grafton Street, W. Pamphlet relating to electric coal-cutting machinery. Half-tone and diagrammatic illustrations, appear

together with full descriptive account of the electric chain brest machine and its operation; also brief references to Long-Wall mining machines.

Messrs. Ward & Goldstone, Manchester. Several new illustrated price lists particularising their main fuses in iron cases with Vitro patent lining, watertight lighting fittings for factories, mines, &c., socket and battery fans, "Brillia" electric lamps, electric bells and accessories and wires therefor, fuseboards, "Multum," Knowle, and other switches.

Messrs. Johnson & Phillips, Old Charlton. Circular giving very lengthy list of corporations, companies, country mansions, hospitals and other public institutions, theatres, railways, ships, &c., using their electric light and power cables.

The James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, E.C. Collection of price lists neatly bound together, showing in detail their well-known Blackman fans and electric motors for continuous and alternating-current service; also Keith-Blackman rheostats for fan motor-starting and regulating, electric motor and blower for smiths' fires, furnaces, &c.

Messrs. Ferranti, Ltd., Hollinwood. Catalogue No. 17 giving full illustrated description, with prices, weights, code words, &c., of their alternating instantaneous action maximum current relay for controlling automatic switches.

Salt Lake Hardware Co., Salt Lake City, Utah. Illustrated lists of Keller assay balances.

Brush Electrical Engineering Co., Ltd. Picture postcard, slightly in excess of the accustomed size, with an imposing illustration in striking colours of one of the electric coaches supplied by the company for the Metropolitan District Railway. Another view on the face of the card shows the building of these coaches in progress at the Falcon Works.

Gramme Circuit-Breakers.—A new series of circuit-breakers has been patented by the Societe Gramme, of 144, Gray's Inn Road, W.C., in which some interesting features are embodied. The circuit-breaker, which is provided with a carbon break, can be opened by hand as well as automatically, and the operating lever is separate from the contact arm, with which it engages by means of a trigger. There is a second trigger attached to the base of the circuit-breaker, which retains the operating lever, and, therefore, the contact arm, in the closed position when the conditions are normal; but in the event of an excessive current flowing, both these triggers are tripped, and the breaker opens. If now the attendant closes the circuit-breaker while the cause of the excess current persists, the breaker instantly re-opens, and cannot be held closed by force. The arrangement of the triggers is very ingenious and effective.

From Bombay.—Messrs. Marshall & Co., electrical engineers, contractors and mill furnishers, of Esplanade Road, Bombay, are inviting firms in this country to send particulars and prices of electrical specialities. During the last two years the firm has put down electric light plants in 12 large cotton spinning mills in India. Bombay will shortly be having a public supply of electric light and power available.

For Sale.—The Leigh electricity department offers a three-wire switchboard for sale.

Dissolutions and Liquidations. — Steam Power Syndicate, Ltd.—Winding up voluntarily with Mr. H. W. Wilkinson, 2, Queen Anne's Gate, S.W., as liquidator.

Automatic Electric Railway Signal Co., Ltd.—Meeting to be held at 5, Castle Street, Liverpool, on July 10th, to hear an account of the winding up from the liquidator.

A. R. Holmes & Co.—Messrs. A. R. Holmes and C. W. S. Nicholson, accumulator manufacturers and electrical engineers, 231, Liverpool Road, Islington, N., have dissolved partnership. Mr. A. R. Holmes will attend to debts.

Cable Accessories Co.—Messrs. R. G. Linscott and G. C. Hurrell, electrical engineers, 14B, Aston Street, Birmingham, have dissolved partnership. Mr. Hurrell will attend to debts and continue the business under the old name.

W. Brooks Sayers.—Notice of dissolution of partnership appears among our "Official Notices" to-day. Mr. J. E. Sayers will carry on the consulting and other business at 157, West George Street, Glasgow, and Mr. W. B. Sayers will devote himself to patent developing and machine designing work at 189, St. Vincent Street, Glasgow.

Trade Announcements.—The Weston Electrical Instrument Co., of U.S.A., have a branch office and laboratory in London at Audrey House, Ely Place, Holborn, E.C., under the management of Mr. A. Davy.

Mr. George Lister, of Dursley, Gloucestershire, has been appointed sole agent for Messrs. W. T. C. Macallen & Co., for the British Empire and Europe for the sale of their tramway equipments, insulating material, &c.

Messrs. J. S. Henry, Ltd., have opened showrooms at 22, St. James' Street, Piccadilly, W.C., for their wooden electric light fittings. The showrooms are well decorated and furnished.

The D.P. Battery Co. inform us that from June 1st all inquiries should be sent to them at Lumford Mills, Bakewell, Derbyshire, from which address the business of the company will in future be conducted.

Messrs. Elliott Bros. notify that their arrangement with the Weston Electrical Instrument Co., of Newark, N.J., terminated several months ago. They have still a stock of Weston instruments on hand, and should any of their customers require such instruments to match those already supplied by them they retain all the records of instruments supplied, and can, for some time to come, fill any orders at a reduced price. They will continue to undertake repairs and recalibration of instruments. Having had 10 years' experience in the adjusting and handling of moving-coil instruments, Messrs. Elliott Bros. have had special opportunities of studying their weak points, and the method of overcoming them, and they draw attention to the complete set of improved moving-coil instruments which they are putting on the market, a number of which are in use in Government departments, central stations and technical institutions, &c.

Bankruptcy Proceedings. — Robert Foster.—At Burnley County Court on June 1st, Robert Foster, late of the firm of Foster & Baker, electrical engineers, of Burnley and Nelson, applied for an order rescinding an order of discharge granted on February 16th last, and for the granting of a new order of discharge. Judge Bompas, K.C., said it was clear that under the circumstances debtor should have his immediate discharge if he would do what was reasonable. The original debts were £1,348, and a dividend of 10s. in the £1 would be £674, and his assets were £201. That left £473 short, and if he had now got a situation at £300 a year, he ought to be able to pay £100 per annum without any difficulty. He would have thought that he might be paying the £100 for five years without any serious unhappiness. Why should not he pay £100 yearly, until he paid £473, and met the 10s. in the £, and then he would be in a position in which a man usually could get off? Mr. F. Roberts (for the debtor) said that when his Honour made the order in the first instance, he fixed the sum at £250, and made Foster pay his share towards making up the assets to 10s. in the £, saying that that sum would just about make up his share. It seemed hard after Baker had got off scot free that Foster should have to pay the whole lot. Foster's position when the order was made, was that he had a salary of £150 a year, and at that time it would have been a physical impossibility for him to have carried out the terms of the judgement. It seemed hard now that he would be in a position to do it, he should not be able to take advantage of it. Since the matter was before the Court last the debtor had reported the facts to the Aston T.C., and that body did not consider it desirable to appoint anyone to the position of electrical engineer with a big load of debt over him. He would be a public servant, and the Committee of the T.C. thought that £250 was as big an amount as he should have hanging over him. The Judge said that was a very good reason for not making the debtor pay more, but he should have thought whether it was £250 or £500 would not have made much difference. However, a bird in the hand was worth two in the bush, and the discharge was granted subject to debtor paying £250 by £50 each half-year.

A. G. Inbig (electrical engineer, Tottenham and Woking). —Receiving order made May 30th on creditor's petition.

Alexander Holland.—The statement of affairs in connection with the failure of Alexander Holland, trading as the Electrical and Mechanical Engineering Co., of 13, Bridgwater Street, Farnworth, Bolton, shows liabilities amounting to £325, assets estimated to realise £31, and a deficiency of £294. Debtor attributes his failure to insufficient trade and low prices. He commenced business under the above mentioned style in 1900 in partnership with Wm. Bullen and John Cope, both of whom shortly afterwards retired. Since then the business has been continued on his own account by the debtor.

Fred. Shaw, electrical contractor, Hull.—Receiving order granted on June 1st on debtor's own petition.

High Pressure Discharges.—Referring to our report of the Royal Society Conversazione last week, in which, in connection with the exhibit of Messrs. Isenthal & Co., we said, "the motor-driven commutator appears to be a substitute of doubtful advantage," Messrs. Isenthal point out that, as this commutator is built exactly on the lines of any commutator, such as forms part of their dynamos and motors, it seems to them to possess an immense advantage as compared with interruptors of any kind, whether of the mercury type or an electrolytic variety. Just as the commutators of dynamos and motors can be relied upon to run for long periods without any skilled attention being given them, so, they urge, can the commutator of the new apparatus be relied upon to perform its function, whilst the interruptor distinctly does not fulfil this condition. The sparking at the commutator brushes is nil, owing to the peculiar arrangement of the electrolytic condenser in series, and not in parallel, with the contact points. Moreover, the commutator of the new arrangement is also designed to convert continuous current sparklessly into alternating current of periodicity suitable for many physical and technical purposes, and finally the construction of the apparatus is such that far greater powers can be dealt with than is possible with ordinary interruptors. There are other important features of the new apparatus, which are regarded as of great value.

A Newport (Mon.) Contract.—In respect of the contract of the Britannia Co., to supply a switchboard to the Corporation's power station, the former claim £760 for extras and also about £35 for damage done to a motor-starting panel and equipment which was lent to the Corporation. Acting on the suggestion of Mr. H. F. Parshall, who has had several prolonged interviews with representatives of the company, the Corporation has decided to offer the company £350 in settlement.

The Transvaal.—Returns just to hand show that during the two months ending with February last the imports of electric wire, cables and fittings into the Transvaal attained a value of £40,000, as contrasted with only £17,000 in the first two months of 1904.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—Recently, as announced in the Electrical Review, the Board of Guardians decided to install E.L. plant at the workhouse, and on June 1st it was moved that a loan of £5,000 should be applied for, for this purpose. There was much opposition, and, by 13 votes to 8, it was decided not to apply for the loan. A member gave notice of his intention to move the recission of the resolution approving of the E.L. installation.

Batley.—The annual report of Mr. S. D. Jones, electrical engineer to the Corporation, shows that at March 31st last, the capital expenditure amounted to £36,068, an increase of £8,135 compared with 12 months ago. The total revenue was £3,764, and the total cost £2,167, leaving a gross profit of £1,597. After payment of interest and sinking fund (£1,931) there remained a deficit of £334. In the eight months of the previous year there was a deficit of £864. At the end of March last the number of consumers was 96, of whom 25 were power consumers, having 38 motors, with a capacity of 230 H.P. The total price per unit, including traction, was 1·76d, against which the cost per unit was 1·15d., and, with interest and sinking fund, 2·18d. per unit. Considering the scattered nature of the district, and the low price obtained for energy, the results of the year's working are regarded as satisfactory.

Beckenham.—The lease of the British Insulated and Helsby Cables Co. in connection with the electric light undertaking expires at the end of this year, and the U.D.C. has decided to take over the undertaking, and extend it as it may think proper, the consideration being a payment of £100 to the company. The Council concedes revised prices for house services claimed by the company, and the latter will supply cables for two years from the expiration of its contract. The company will continue to work the station at its own risk until the contract expires. Plans and specifications for extending the buildings, and providing a new 250-KW. generator with the necessary boilers, &c., are to be prepared; the extension of the power house will provide sufficient space to accommodate machinery for the supply of the Penge tramways. The lease expires on November 22nd, and for the year ending March 31st, the loss on the undertaking was under £400, this being due to the destructor.

The U.D.C. has recently lost a large contract for the supply of energy under somewhat exceptional circumstances. When the company now known as the South Metropolitan Electric Light Co. agreed to purchase the undertaking of the Crystal Palace District Electric Lighting Co., the Council successfully claimed the right to purchase that portion of the undertaking which came within its district. Shortly after this the Council received an application from the directors of the Crystal Palace for terms on which it would be prepared to supply that building with energy for illuminating purposes. The negotiations proceeded, and the question arose as to whether the Council would be supplying outside its own district. A portion of the Crystal Palace and grounds comes within the Beckenham area, but the larger portion of the Palace comes within the Penge district, over which the South Metropolitan Co. has exclusive powers to supply energy. It has been decided that any attempt to supply the Crystal Palace would land the Council in serious litigation, and therefore it will not proceed further with the negotiations with the Crystal Palace Co.

Bradford.—The Electricity Committee has recommended the T.C. to apply to the L.G.B. for a loan of £60,000 for electricity purposes.

Burton-upon-Trent.—Below we give in brief the results of the past year's working (ended March 31st last) of the Corporation electricity undertaking, together with the figures for the preceding year:—

	1904-5.	1903-4.
Total revenue	£9,791	£8,962
Works cost	5,432	4,312
Balance, less interest and sinking fund charges	+ 357	+ 1,197
Average price obtained per unit	2·32	3·1
Total cost per unit	1·32	1·52
Units sold	986,933	678,020
No. of equivalent 8-C.P. lamps connected ..	32,111	26,300
Plant capacity	1,610 KW.	1,110 KW.
Maximum load (lighting and power only) ..	427 KW.	370 KW.

During the past year an alternative flat rate of 5d. per unit was introduced, the result of which was that some consumers had the price of energy reduced 1d. per unit. Lamp connections increased 14·2 per cent. against 12·2 in the previous year, and the sale of units only 5 per cent. against 18·3 per cent. in 1903-4. Motor connections are very satisfactory, and with 102·5 H.P. in hand brings the total up to 306·75 H.P. The smaller surplus last year is attributed to the adoption of a flat rate and depression in trade.

Chatham.—A fire which destroyed the generating station belonging to the Kent Electric Power Co., broke out at 1 o'clock on Friday morning last. The station is used for supplying electric light and power in the towns of Chatham, Rochester and Strood, so that the greatest possible inconvenience was caused in the district. After negotiations, arrangements were made for taking a supply of energy offered by the Gillingham Corporation. The chief difficulty in the way of doing this was the provision and laying of a high-tension main, over 1,000 yds. long, across the ground known as the "Chatham lines." The consent of the War Office was, however, obtained, and in all probability the supply will be again available for the public immediately after the holidays. In regard to the permanent supply, the Kent Electric Power Co. anticipates that its new power station at Frindsbury will be in a position to supply energy before the end of the present year.

Continental Notes.—Spain.—A water-power plant is to be erected at Cabrera on the banks of the Moya, to supply electricity for lighting and power purposes.

The generating station of the Sociedad Hidro-Electrica Miestra Senora del Socorro has just been inaugurated. It is situated on the River Genil, and supplies energy for lighting purposes to the towns of Osuna and Herrera (Seville) distant respectively about 23 and 5 miles.

Italy.—A concession has been obtained by the Societa per la Tramoia Pinerolo-Perosa to put down a hydro-electricity generating plant on the Chisone, for the operation of its tramway system.

France.—The committee appointed by the Paris Municipal Council has returned from its tour of inspection of electricity works in the principal cities in Europe, the visits having been paid for the purpose of gathering information which might assist in determining the question as to the future position of the electric lighting industry in the French capital. As a result of the investigation, it is said that the committee reports conclusions which are entirely different from those arrived at by the Technical Commission in Paris. The points of difference relate to the maximum power of the proposed turbines, the sites most suitable for the generating stations, the pressure to be used, and also in regard to the supply, which in foreign cities is more popular than in Paris. Pending further developments it may be mentioned, according to the report of the Compagnie Continentale Edison, that the municipal authorities made an offer to the company with a view to the latter's concession being prolonged for a short period. The conditions sought to be imposed are, however, of such a character that the directors have refused to accept them. In the meantime further negotiations have been embarked upon.

Darlington.—The statement of accounts of the Corporation electricity department for the year ended March 31st last shows a profit, after payment of interest and depreciation, of £1,450, equal to about one-half the loss on the year's working of the municipal light railways. From the end of the present month the Corporation has decided that the charge for energy shall be 4d. per unit up to 20,000 units, and 3½d. per unit above that amount. For power purposes the charge will be reduced to 1½d. per unit for the first 500 units supplied per quarter, and 1¼d. beyond.

Eastbourne.—The T.C. has decided to reduce the price of electricity for lighting from 6d. to 5½d. per unit. The accounts of the undertaking for the past year show a net profit of £2,725, £2,000 of which has been placed to the depreciation fund, and £725 to the relief of the rates.

Grays.—The U.D.C.'s E.L. undertaking last year yielded a gross profit of £1,373, and a net surplus of £209.

Grimsby.—The T.C. on Friday adopted an agreement to supply energy to the Railway Co. for the Docks, on the maximum demand system at a fixed charge of £4 per annum per KW. of maximum demand, and ¾d. per unit for all energy consumed in excess.

Hanley.—The T.C. has applied for a loan of £11,000 for electricity purposes for the next three years.

Lancaster.—The Corporation electricity undertaking last year yielded a net profit of £585, against £1,507 in the previous year. The surplus has been carried to the reserve fund, which now stands at £4,826.

Leyton.—The U.D.C. has received from the L.G.B. permission to raise a loan of £5,000 for E.L. purposes.

London.—City.—The Corporation has sanctioned the expenditure of £500 on re-wiring in connection with the systematic re-wiring scheme, now in progress, of the Library, Museum and new offices of the Guildhall.

Southwark.—The Electric Power Supply Co. has written to the Council, offering, in order to meet the Council's objection to its Bill, to give an undertaking to supply energy in bulk at a price which will enable the Council to sell at ¾d. per unit for power and 2½d. for lighting. The offer is to be considered.

Westminster.—Tenders for the street lighting of the parish of St. James, from the St. James' and Pall Mall Electric Lighting Co. and the Gas Light and Coke Co., both practically for the same amount—viz., £17 per 700-C.P. lamp per annum for 66 lamps for five years—were discussed at the meeting of the Council last week. The advocates of gas took exception to the figures in a report from the engineer (Mr. Bradley), on the relative cost and general advantages of the rival systems, and moved that the town clerk and the treasurer be instructed to bring up a report upon the same matter. This was carried.

Battersea.—Application is to be made to the L.C.C. for a loan of £8,830 for extension of electric plant and mains.

Hackney.—Application is to be made by the B.C. to the L.C.C. for a loan of £18,810 for electrical purposes, as follows:—Mains, £11,861; public lamps, £1,301; plant, including artesian well, £2,152; demand indicators, £1,500; &c.

Malton.—The U.D.C. has decided to ask the Northern Counties Electricity Supply Co. to tender for lighting the district by electricity, in accordance with the terms of an agreement entered into in December, 1899, by which the company is to supply energy at 30 per cent. less than the price paid for gas.

Worcester.—The T.C. is applying for a loan of £6,010, the amount overspent on the electricity capital account for machinery, extension of mains, &c.

(*Continued on page* 943.)

THE ELECTRIFICATION OF THE METROPOLITAN DISTRICT RAILWAY.

(*Continued from page* 901.)

The Lot's Road power station of the Underground Electric Railways Co. of London is situated at the junction of Chelsea Creek with the River Thames, the former bounding it on the south side of the boiler house.

It is destined to supply energy for working the whole of the District Railway system, and also the Baker Street and Waterloo, the Great Northern and Brompton, the Charing Cross and Hampstead, and the Edgware and Hampstead Railways, and certain tramways south of the Thames. These will unitedly represent by far the heaviest and densest traffic of any electric railway network, and some idea of its proportions, as also of the scope of the power station plant, can be gained from the fact that 24 sub-stations will be required, in which will be installed 77 rotary converters with a total capacity of 87,500 KW.

Such a scheme has necessarily called for a generating station of unusual proportions and design; the Lot's Road power house, when complete, will contain 80,000 H.P. of generating machinery, and cover more than 3½ acres of land, including yards, &c., the cost being some 2½ millions sterling.

The size of the building and the plant which it contains has necessitated the greatest care in laying the foundations, which consist of about 220 concrete piers, which have been sunk through to the London clay at a depth of 35 ft.

The necessity of making all the excavations watertight as they proceeded was a troublesome and costly one; but the fact that they were well below the river level, even at low tide, made this course imperative.

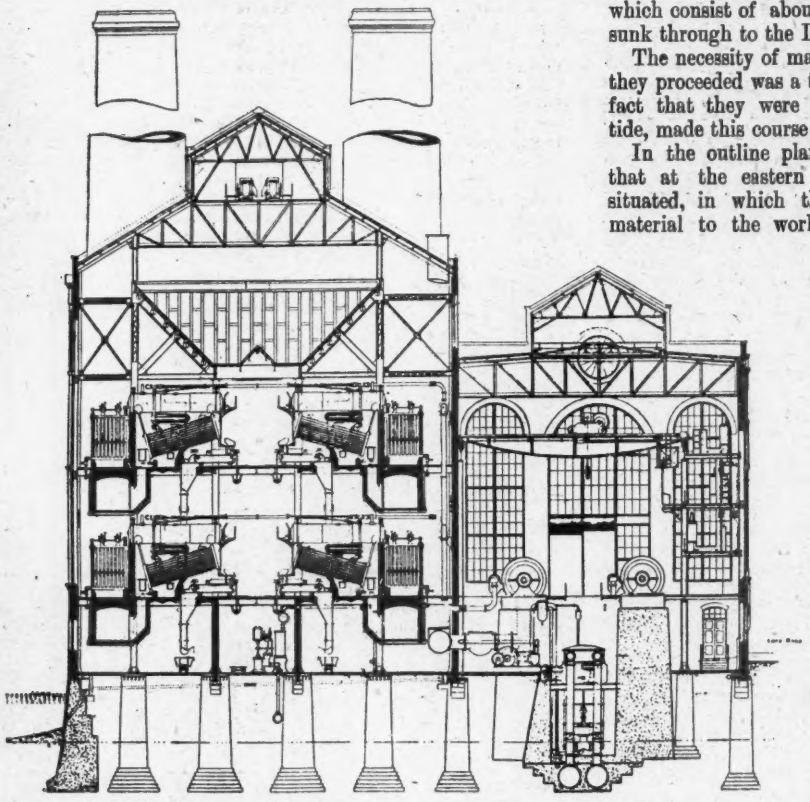
In the outline plan of the site, fig. 23, it will be noticed that at the eastern extremity a spacious barge basin is situated, in which the barges conveying coal or other material to the works are unloaded. Behind this is a building containing the oil-cooling plant, and at the other extremity of the site the ash-handling equipment is installed. Further westward still, on the opposite side of Chelsea Creek, are situated the sidings of the West London Extension Railway.

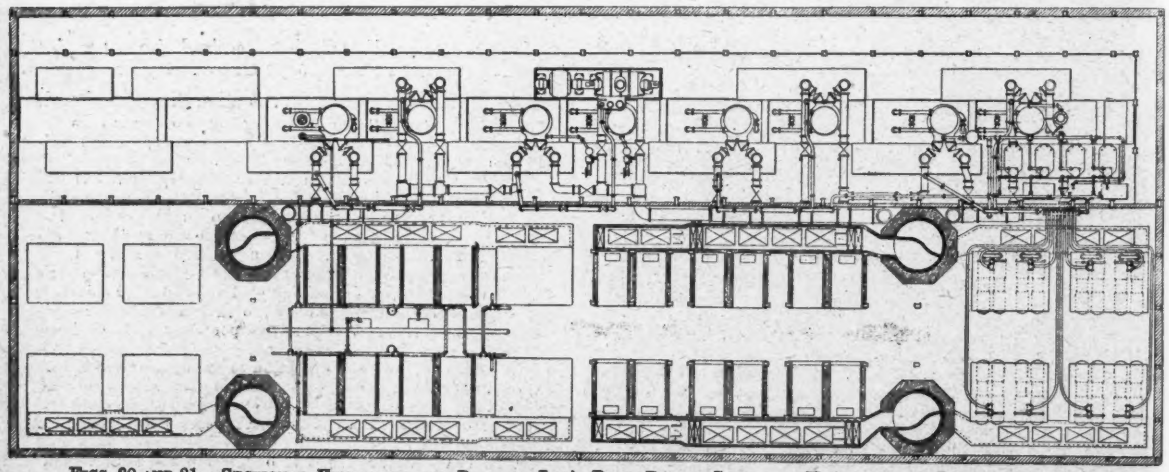
Clearly the power plant is most advantageously situated in regard to its enormous requirements in fuel and in water for condensing purposes, the proximity of the River Thames and of a railway, affording not only working, but also constructive, facilities of great value.

In the construction of the buildings, little less than 20,000 tons of steel have been used, of which some 6,000 tons were required for the main framework.

The internal arrangements of the power station, which is 453 ft. long × 175 ft. wide and 140 ft. high, are shown in plan and sectional elevation in figs. 20 and 21. It is divided longitudinally into engine and boiler rooms, the latter containing several floors. The arrangement of the boilers upon two floors is a decidedly novel one in England, but represents almost standard American practice; it was a necessity in this case, owing to the large number of boilers installed, and considerations of floor space.

The engine room contains Westinghouse-Parsons turbo-generators arranged in two rows longitudinally, with the





FIGS. 20 AND 21.—SECTIONAL ELEVATION AND PLAN OF LOT'S ROAD POWER STATION: UNDERGROUND RAILWAYS COMPANY OF LONDON.

condensing plant in the basement, between the two ; the main switchgear occupies the whole of the Lot's Road side of the building, and is arranged in three galleries ; the auxiliary plant and station switchgear is installed at the eastern end of the building.

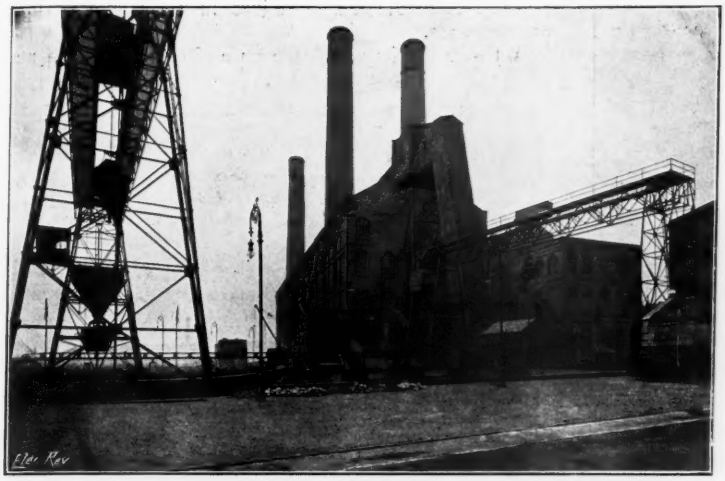


Fig. 22.—Exterior of Power Station, showing Coal-Handling Plant, Oil Cooling House, &c.

Naturally, the coal-handling plant for this station is of very extensive proportions.

Coal is picked up from barges in the basin, by two 1-ton grab travelling cranes, shown in fig. 22, which span the basin. Passing through weighing machines attached to the cranes, the coal falls on to a 30-in. horizontal belt conveyor running some 190 ft. along the quay side, which delivers it to a coal-crushing machine, from which it subsequently drops into either of the two inclined bucket conveyors provided at the eastern end of the boiler house.

The latter apparatus, with a working capacity of 240 tons per hour, raises the coal to the top of the building, a height of 145 ft., and deposits it on to one or other of two horizontal 24-in. belt conveyors, which run the length of the coal bunkers, a distance of some 980 ft.

These conveyors, which are provided with "throwing off" carriages, which can be travelled to any desired position over the bunkers, are illustrated in fig. 26.

Needless to add, the various cranes, elevators and conveyors are all electrically operated ; the travelling cranes run on railway tracks on either side of the barge basin, and take power through a conduit and plough, the former laid in the track. The belt conveyor on the quay, is operated by means of a 15-B.H.P. motor ; the bucket conveyors are each driven by a 30-B.H.P. motor situated at the top of the conveyor structure, and each conveyor over the bunkers is provided with a 20-B.H.P. motor situated at the end of its run.

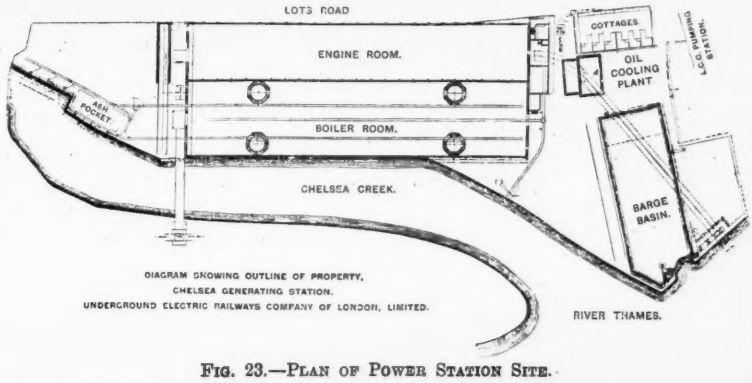


Fig. 23.—Plan of Power Station Site.

As an alternative to water-borne coal, arrangements have been made to obtain a supply of fuel from the sidings of the West London Extension Railway, and to bring the coal in at the opposite end of the bunkers.

The coal bunkers have a capacity of 15,000 tons, with which to cope with the anticipated daily consumption of some 800 tons of fuel.

The boiler house will ultimately contain 80 Babcock & Wilcox water-tube boilers, of which 64 are installed, supported directly on the steel framework of the building, on two floors. Each possesses 5,212 sq. ft. of heating surface, and is provided with a superheater of 672 sq. ft. area ; the evaporative capacity per boiler is some 18,000 lb. of water per hour, at a working pressure of 175 lb. per sq. in. The boilers are divided up into sets of eight, the number required to operate each turbine unit at full load. There is no steam connection between the various groups except in one case, where a header for supplying steam to the auxiliaries is fed from two of them. Chain grate stoking gear is provided, with 83 sq. ft. of grate surface for each boiler.

The boilers are illustrated in fig. 24.

Twelve Green economisers, each consisting of 576 tubes, and eight of half that size, giving a total of 9,216 tubes, are installed in groups behind the boilers.

They are erected immediately over the main flues, the latter running under the boiler house floors, and so arranged that any boiler unit can be isolated. The scraper gear for each section of 576 tubes is driven by an electric motor through worm reduction gear, there being 16 such driving motors in all.

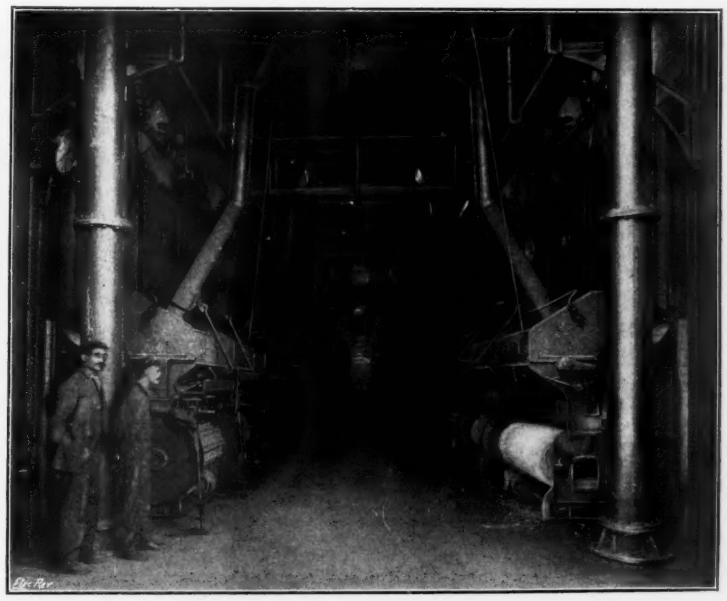


Fig. 24.—View of Upper Boiler Floor.

The main flues lead into the chimneys, of which there are four. These are built on the Custodis principle, with an internal diameter at the base of 19 ft., and a height of

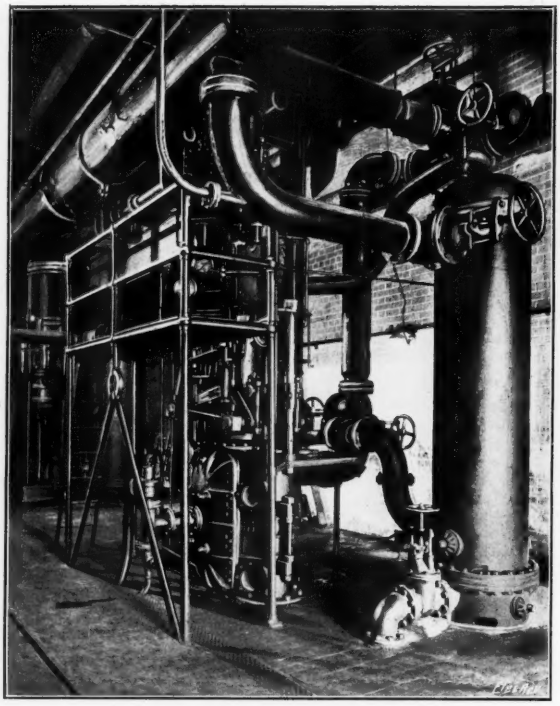


Fig. 25.—Triple-Expansion Heisler Feed Pump, in Boiler House Basement.

275 ft., and are placed symmetrically, in pairs, in the boiler house section, about a quarter of the length of the building from the ends. The foundations for each chimney measure 42 ft. square, and have a depth of 35 ft.; there are few stacks in Europe that can equal them in size, as they have been designed with a margin for extensions beyond even the present enormous capacity of the station.

The steam piping was supplied by Messrs. Babcock and Wilcox, and is of solid drawn weldless steel.

The pipe arrangement which follows the unit system, consists of 6 in. boiler branches from eight boilers, connected to a header, the latter in turn supplying through a 14-in. lap-welded steel pipe, one turbo-generator unit; all the generating units being distinct in their steam supply arrangements.

A 10-in. auxiliary header, connected to two of the main

Fig. 26.—View of 24-in. Belt Conveyors over Coal Bunkers

headers, supplies steam to the exciters and air-compressing plant.

Our illustration, fig. 29, shows the steam piping and economisers in the upper boiler room, the coal bunkers being overhead.

The basement of the boiler house is divided into three parts, the centre one being utilised as a pump room and the others for the ash-handling plant. In the pump room there are installed a row of seven Worthington and one Heisler steam pumps; the former are of the vertical simplex compound type, and the latter, which we illustrate in fig. 25, is a triple-expansion vertical pump fitted with a compensating valve gear.

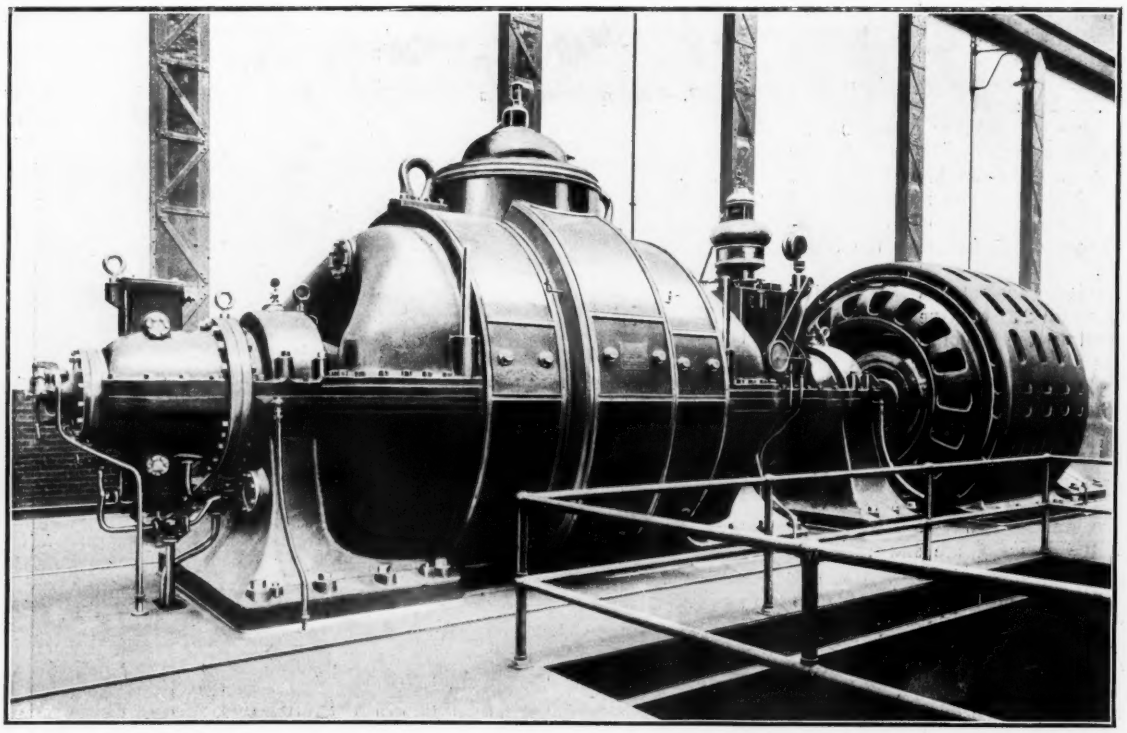


Fig. 27.—Westinghouse-Parsons 5,500-kw. Turbo-generator, Showing Opening to Condenser Basement.

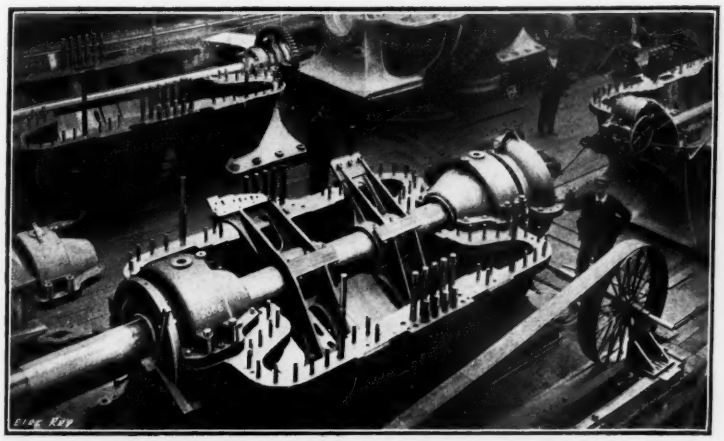


Fig. 28.—Turbine Cases under Construction.

Each pump has a rated capacity of 18,000 gallons per hour against a pressure of 225 lb. per sq. in.

The feed water supply for the plant is obtained from an artesian well, 575 ft. in depth, by means of a compressed air lift; this well is situated behind the oil cooling house, and supplies a large storage tank arranged in the latter; from here the water feeds through an auxiliary feed tank to high and low level feed suction pipes in the pump basement.

As an alternative, a connection is provided to the public water supply, and a further one to the barge basin allows river water to enter into the low level suction.

The condensed steam (or hot well discharge) is fed into the high level suction and falls through feed heaters which utilise the pump exhausts, into the lower suction pipe, form which it is pumped through the economisers to the boilers; independent ring feed mains are arranged to take a supply from either of two pumps, and to feed either or both of two boiler groups.

The heaters exhaust through a common main to atmosphere, any condensation draining to a sump.

For handling the ashes from the boilers, a narrow gauge railway and suitable self-dumping trolleys are provided in each outer basement; these receive the ashes from shoots and allow of their haulage by a B.T.H. accumulator locomotive to the yard at the western end of the building, where they are dumped into a storage bin; they may as an alternative be loaded direct into barges by means of pneumatic cranes, situated at the side of the creek.

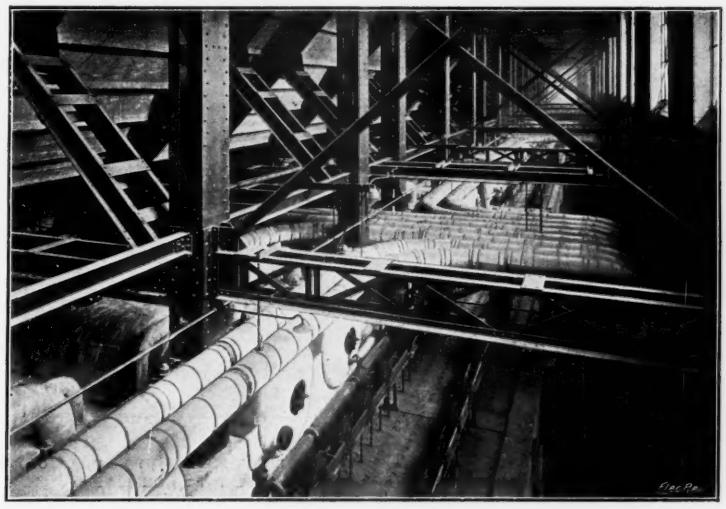


Fig. 29.—View of Boiler Steam Branches Leading into Header; also of Economisers and Bunkers Overhead.

The engine room, which is one of the features of the station, both on account of the turbine plant and the switchgear there installed, will contain ten Westinghouse steam turbine generating sets, each consisting of a turbine of some

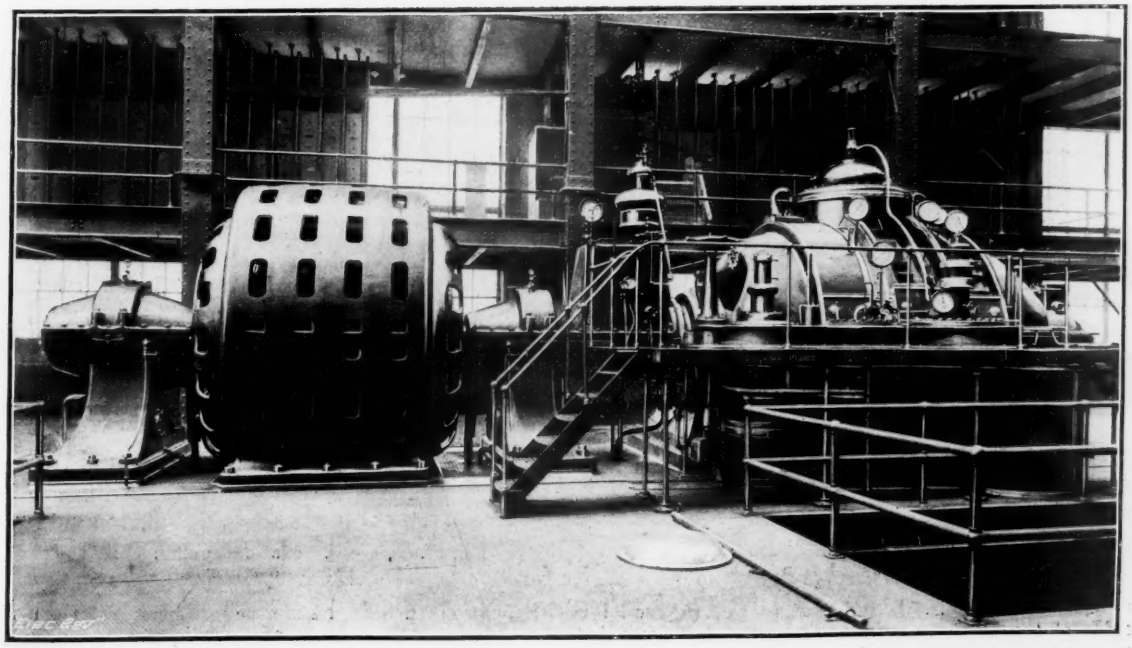


Fig. 30.—Westinghouse-Parsons 5,500-kw. 3-phase Turbo-generator, Showing Operating Platform, &c.

7,300 B.H.P., coupled direct to a three-phase alternator of 5,500-KW. capacity. The floor space, however, is available for an additional 2,750-KW. unit. The turbines are of the Westinghouse single-cylinder, double-flow type, and are designed to run with a steam pressure of 165 lb. per sq. in., a superheat of 100° F., and at a speed of 1,000 r.p.m. They are capable of sustaining an overload of 50 per cent. by aid of automatic by-passes, and are extremely economical in steam consumption.

As these turbines are the largest in Europe at the present time some details of their construction and operation may be of interest. The rolled steel rotating drum to which the blades are fixed is 77 in. in diameter, and is fitted at each end with forged-steel umbrella-shaped disks, shrunk in, the steel shaft being pressed into these. The first series of blades are of drop forged steel, dovetailed and caulked into grooves cut in the surface of the drum; in the case of the low-pressure series, they are of delta metal, on account of the corrosive action of wet steam. The main bearings are of the spherical type, and are of cast-iron with babbit metal linings, and provided with a cooling water circulation.

Forged steel flexible claw couplings running in oil are provided for connecting the turbine rotors with the revolving fields of the alternators, and are so arranged as to provide for any inexactitude in the alignment of the two shafts.

The course of the steam through the turbine is as follows:—Leaving the main "disk-type" stop-valve, which is actuated by gearing from the platform, the steam flows through an emergency shut-down valve, a strainer and a double-seated poppet governor valve; the latter being operated by a steam relay controlled by the centrifugal governor. It now enters the cylinder at the centre, and passing through a series of nozzles and impulse blades, expands down to practically atmospheric pressure, continuing then through a number of pressure blades on the Parsons principle to the condenser. An emergency governor is arranged at the opposite end of the spindle to the centrifugal governor; this acts if the speed of the turbine, from any cause, rises to a predetermined maximum, opening an auxiliary valve which, in turn, closes the emergency throttle valve.

A speed variation of 10 per cent. above or below the normal can also be effected by means of an electrical control operated from the control board.

The steam flow, in opposite directions after its admission at the centre of the turbine, eliminates all end thrust, and obviates the necessity for balance pistons. One end of the shaft is fitted with a thrust block to allow of longitudinal adjustment of the turbine rotor, and a central system of lubrication supplies oil under pressure to each bearing, through a separate pipe.

About 30 gallons of oil per minute is supplied to the bearing oil circulation system, and the water-cooling

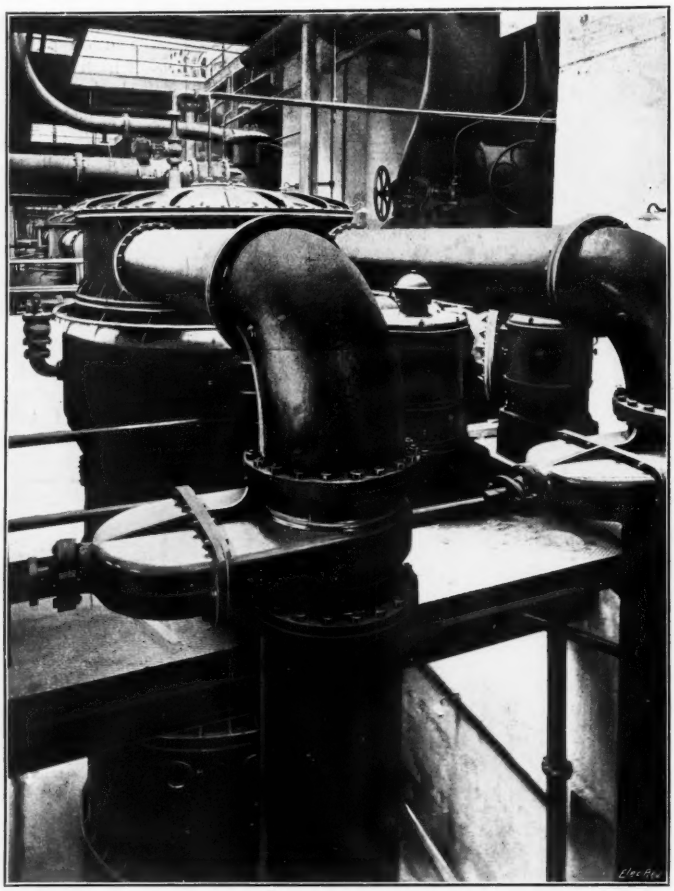


FIG. 31.—VIEW OF CONDENSER UNIT, SHOWING CIRCULATING AND LIFT PUMP MOTORS, ALSO MAIN EXHAUST PIPES AND VALVES OPERATED BY COMPRESSED AIR IN BACKGROUND.

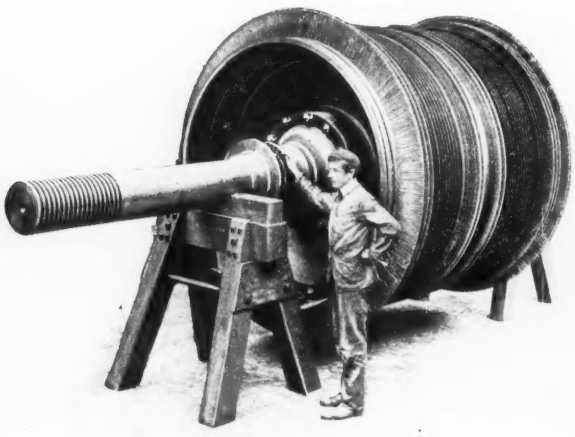


FIG. 32.—5,500-KW. TURBO-GENERATOR: COMPLETE TURBINE ROTOR.

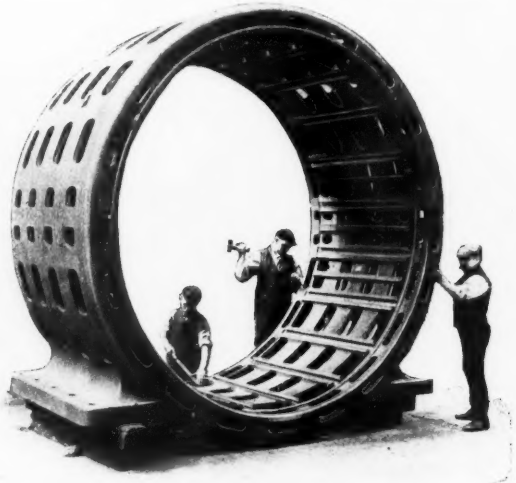


FIG. 33.—5,500-KW. TURBO-GENERATOR: ARMATURE UNDER CONSTRUCTION.

jackets to the bearings require approximately 40 gallons of water per minute, when used.

The three-phase Westinghouse alternators are of the revolving field type, and on a non-inductive load, will each supply a current of 289 amperes per phase at a pressure of 11,000 volts. They each are of 5,500 KW. capacity with a frequency of 33·3 per second. The revolving field is a solid forging of Whitworth fluid pressed steel of good permeability, and is wound in the usual manner. The armature-core of laminated iron is supported by a heavy cast-iron frame, divided horizontally, and is wound in slots on its inner surface. The normal excitation current is 180 amperes at 125 volts, when the generator is delivering its full load at unity power factor.

The guaranteed electrical efficiencies of the electrical generators on non-inductive load are as follows :—Full load, 97·25 per cent.; ¾-load, 96·5 per cent.; ½-load, 95 per cent.; and ¼-load, 90 per cent.

The combined turbo-generators, when running at a speed of 1,000 r.p.m., with steam at 165 lb. per sq. in. pressure, superheated to 100° F., and exhausting into a vacuum of 26 in. and 27 in. respectively, have a steam consumption per KW. approximately as follows :—

Output.	Lb. steam per KW.-hour. 26 in. vacuum.	27-in. vacuum.
One and one quarter load, 6,875 KW. ...	16	13·6
Full load, 5,500 KW.	15·6	13·2
¾-load, 4,125 KW.	17·2	15·0
½-load, 2,750 KW.	18·4	16·0

Figs. 27 and 30 give an excellent idea of the turbo-units. The turbines each exhaust through two 44-in. diameter pipes to the condensers, which are on the dry vacuum principle, with separate motor-driven air and water pumps. The main exhaust valves, on account of their size, are operated by means of small compressed air motors. Ten vertical surface condensers will ultimately be installed in pits between the two rows of turbines, each having 15,000 sq. ft. of cooling surface. Circulating water is conveyed to the condensers through two 66-in. pipes, which extend from the centre of the river opposite the entrance to the barge basin, and run under the condenser pits, where they are embedded in concrete. These pipes are each some 1,500 ft. long, and are provided with suitable valve chambers at the river bank; they are used alternately for injection and delivery, the reversed flow (every 24 hours) removing any sediment which enters.

Each condenser is provided with a 20-in. motor-driven centrifugal pump, which is utilised only for the purpose of overcoming friction, as the system is arranged on the syphonic principle, the tops of the condensers being within 29 ft. of minimum low tide, and the circulating circuit closed.

A horizontal electrically-driven dry vacuum pump and 5-in. centrifugal pump for lifting the condensation water up to the feed pump suction piping are provided for each condenser.

The 20-in. and 5-in. centrifugal pumps are of the horizontal type, arranged in the bottom of the condenser pits, the motors for driving them through vertical spindles, being fixed at the ordinary basement level.

The arrangement of the condensing plant will be seen in figs. 20, 21, 31, &c., the latter giving an excellent idea of the proportions and situation of these condensers in relation to the turbines.

An alternative atmospheric exhaust is provided to each turbine, which has a connection through an air-controlled automatic valve to one of four 60-in. pipes, which run up at the side of the chimneys to roof level. The condensing equipment was supplied by Messrs. J. H. Simpson & Co.

(To be continued.)

German Imports and Exports of Electrical Machinery.—So far this year there has been a slight increase in the imports of foreign electrical machinery into Germany, the returns for the three months ending with March last showing a total of 333 tons, as compared with only 298 tons in the corresponding period of last year. On the other hand, there has been a decline in the exports of German electrical machinery—from 3,434 tons in the first three months of 1904 to 3,367 tons in the quarter ending with March last.

LIGHTING AND POWER NOTES.

(*Concluded from page* 937.)

Long Eaton.—The accounts of the electric light department for the year ending March 31st, 1905, show a net profit of £421. The income for the year was £3,343.

The U.D.C. has decided to reduce the prices of energy as under :—Private lighting, 4d. per unit; factories, 3d. and 2½d. to 1d., according to consumption.

Morley.—The annual report of the Electrical Department for the year ended March 31st last, shows that the total number of units sold was 142,959, as against 142,958 in the previous year. The gross profit, before providing for interest and sinking fund, was £605, equal to 2½ per cent. of the expenditure.

Ossett.—The refuse destructor which has been erected in Church Street, was formally opened last week. It has been designed in conjunction with an electricity works proposed to be erected at the north end of the building. The generating plant will consist of two sets, each of 200 H.P., and a storage battery. Its capacity will be equal to 1,000 8-C.P. lamps for 10 hours. The scheme includes the laying of feeders from the works to the Market Place, along Wesley and Bank Streets, Station and Prospect Roads, Queen Street and Town End. From these, distributors are to be extended as necessity arises. The estimate of the cost is £8,400. The prices proposed to be charged for supply are 5d. per unit for lighting, and 2d. per unit for power.

Perth (W.A.).—Owing to the continued growth in the demand for electricity, the Perth Gas Co. has found it necessary to greatly increase the generating plant at its command, and as the existing site is fully occupied, an entirely new power station is being built a mile away from the old one, the central business part of the city lying between the two. The new building is of steel, the engine room measuring 60 ft. × 55 ft., and abundant space is available for future extensions. Two water-tube boilers working at 200 lb. per sq. in. are being erected, and a steel chimney shaft, 125 ft. 6 in. high and 7 ft. 6 in. in diameter, weighing 22 tons, has been constructed on the spot and raised into the vertical position *en bloc*. A British-made steam dynamo of 1,000 H.P. forms the first instalment of the generating plant. The whole of the works have been designed and are being carried out by Mr. H. Broadbent, manager of the Gas Co.'s electricity department, Mr. A. D. Broadbent being in charge of the work.

South Africa.—EAST LONDON.—On the recommendation of the committee, the T.C. has resolved that the minimum charge per month, for energy for electric lighting shall be 5s. with 1s. 6d. meter rent in addition.

JOHANNESBURG.—The new underground electric cables as at present laid in Jeppe, Kerk, Pritchard, President, Commissioner and Saner Streets have been tested with double the normal working pressure, and consumers' services are to be connected as required.

Certain property owners in Ophirton have applied to the T.C. for permission to erect posts and overhead wires for the purpose of obtaining a supply of electricity from the Robinson Deep Gold Mining Co., and the requests have received the recommendation of the Lighting Committee.

BLOEMFONTEIN.—In view of the rapid growth of the town, it is estimated that £50,000 will have to be voted for E.L. extensions during the ensuing 12 months.

DURBAN.—The borough electrical engineer reported that, at the end of April last, the total number of lamps connected to the B.C. mains was 132,159, and the total number of consumers was 2,996. The number of incandescent lamps used for street lighting at that date amounted to 1,172, and connections for power to 159.

PRETORIA.—The T.C. has decided on extensions in connection with the electricity works, by the addition of one 500-KW. Belliss & Morcom-A.E.G. Electrical Co. steam dynamo. Also switchboard, electrically-driven condensing plant, cooling tower, two electrically-driven feed pumps, one Edwards air pump, two circulating pumps, two motors for fans, and one balancer. The contract for the supply and erection complete, amounting to approximately £12,000, has been awarded to the A.E.G. Electrical Co., who are represented in Durban by Messrs. Jenkins & Co.

Sunderland.—The tenth annual report of the Corporation electricity undertaking has been issued by Mr. J. F. C. Snell, the borough electrical engineer. He states that during the last year a great advance was made in the scope of the department, there being now several important shipyards and engine works which rely solely upon it for their motive power. This extended use of electricity will not only react favourably upon the cost of production, but will be beneficial to the town and to the principal industries. There is necessarily still a large amount of capital undeveloped, because of the extra amount of reserve plant rendered necessary by having for the time being, two stations and also three types of plant. This is, however, being rectified. A gross profit of £19,434 on the year's working has been obtained, and, after deducting interest and sinking fund, there is a net profit of £954, which he advises should be added to the reserve fund. The number of equivalent 8-C.P. lamps connected on March 31st, was 289,800 as compared with 197,683 in 1904, representing an increase of 46 per cent. The number of units sold was 4,772,913 as against 3,508,139 during the previous year, representing an increase of 36 per cent. The actual capital outlay to March 31st, 1905, was £304,665, and of this amount £19,738 was spent during the year. The contributions to the sinking fund now amount to £36,120, and the net results, after

the repayment of all sums taken from the rates, leaves £3,146 in the reserve fund. The actual revenue was £43,186. The total working costs were 1·215d. per unit.

Welshpool.—At a public meeting held on May 31st to consider the E.L. question, a resolution was passed asking the T.C. to take into consideration the question of adopting an E.L. scheme. It is suggested that energy should be obtained from Powysland Mills, and it is estimated that it could be supplied for lighting at 6d. per unit.

Willesden.—The U.D.C. has received sanction from the L.G.B. to borrow £2,000 for electric motors. Distributing mains to cost £164, and feeder mains to cost £2,040, are to be laid. To meet future developments of the undertaking, application is to be made to the L.G.B. for a further loan of £20,000, to be borrowed by instalments as required.

The L.G.B. has intimated that it is not aware of any legal authority enabling the Council to charge on the funds of the electrical undertaking expenditure in connection with the proposed Electrical Exhibition, and the Committee is therefore unable to recommend any further action in the matter.

TRAMWAY AND RAILWAY NOTES.

Automatic Signalling.—With the approval of the B. of T., an extensive installation of the "Hall" electro-automatic signals has been put into operation on the busy section of the main line of the North-Eastern Railway, which extends from the Green Lanes Box, Thirsk, to Alne Station, about 10 miles north of York. This system has for some time been in use on other sections of the railway.

Batley.—At a meeting of the Electric Traction Committee of the Corporation on Monday, a cheque was signed for £20,000 for the purchase of the portion of the Dewsbury, Batley and Birstall steam tramways within the borough of Batley. The system belongs to the British Electric Traction Co., who are about to reconstruct and electrically equip the line. The Batley Corporation will lease its portion of the line to the company, and it is understood that the reconstruction of the line will be taken in hand almost immediately after Whitsuntide.

East Durham.—A syndicate, understood to be the same as that which is providing the Houghton-le-Spring district of Durham County with electric traction, has given notice to the local bodies concerned of its intention to apply for a provisional order to construct further lines in the East Durham district, in order to embrace Seaham Harbour, New Seaham, and Murton Colliery—a very populous neighbourhood. The new routes comprise about 8 miles of track, beginning at Ryhope, to which place lines are already laid, and running from there to Seaham Harbour, and then on New Seaham, Murton and South Hetton, to join the system already authorised in connection with the Houghton-le-Spring scheme.

Electric Railway Experiments.—The Berlin Allgemeine Co. proposes to carry out exhaustive experiments on the Northern Railway, with a view to ascertaining the wear and tear of high speed railway material. A trial line is to be constructed in the Royal Forest, near Nassenheide, with a power station situated at the central part. The tests are to extend over a period of five years, and the cars are to be operated daily without interruption for 22 hours out of the 24. The remaining two hours are to be devoted to the purpose of measurements and observations.

Folkestone.—At a meeting of the T.C. on May 31st, it was reported that the National Electric Construction Co., Ltd., of 34, Victoria Street, S.W., had written offering to find the capital for constructing electric tramways in the town under the Council's order, to repay £1,200 costs incurred in obtaining the order, and to contribute £15,000 towards street widening. The Dolter surface contact system would be installed, and the Corporation would have the option of purchase at the end of seven years at capital expenditure, plus an amount for goodwill, viz., the profits of the four preceding years; at the expiration of 15 years at actual capital expenditure plus 25 per cent.; and at the expiration of 21 years at actual capital expenditure only. If the Council raised the capital, the company offered to construct the tramways and to run them, or on a cash contract the company offered to install the system. This is the second company which has approached the T.C. on the tramways question within the past few weeks, and both offers are under consideration. Lord Radnor, who owns nearly the whole of the land in the borough, objects to the use of overhead wires.

Huddersfield.—An electric tramcar got beyond control of the driver on Tuesday last, and ran away. It crashed through a wall 5 ft. high and 2 ft. thick, and dropped into a field beyond. Four passengers on the top of the car narrowly escaped injury, but the driver and conductor, who were the only other persons on the vehicle, were slightly hurt. The car was badly damaged, the front platform being completely smashed.

Leicester.—The report of Mr. E. G. Mawbey, borough engineer, on the Corporation tramways, shows that the cost of the undertaking has amounted to £469,746; the length of single track completed is 36½ miles, making £12,870 per mile of track (inclusive of power station, rolling stock and depôts). The permanent way was laid by the municipal staff, at a cost of £5,865·5 per mile of single track, the construction having been of the best possible quality, and English rails having been used throughout. A considerable balance remains to be expended, there being some 6 miles of track to construct; additional power-station plant is being installed, and extra cars and depôts are required.

Light Railway Progress.—Sir Francis Hopwood's report to the President of the Board of Trade on the proceedings of the Light Railway Commissioners up to the end of last year shows a considerable falling-off in the number of applications made in 1904 as compared with previous years. There were 26 applications, involving an estimated capital outlay of £1,525,600, as compared with 39, involving an outlay of £1,646,100 in 1903, and only 20 orders, involving capital expenditure to the extent of £489,900, were made. Since the Light Railways Act came into force in 1896 nearly 500 applications, involving £33,542 900, have been received, but only 234 orders, involving £11,279,800, have been actually confirmed by Parliament. The mileage applied for has been 4,300, and that granted only 1,600. The chief interest in the Light Railways Act now is the extent to which it can be utilised in promoting highway transportation projects which are really tramways, and the falling-off probably mainly represents a slackening of activity in this respect.—*Financial Times.*

Liverpool.—1½d. fares are about to be introduced experimentally, on four of the Liverpool tramway routes, the routes in question being from the Pierhead—the western terminus by the riverside—to the south-east and east of the city, and ranging from 2½ to 3¼ miles in length.

Liverpool - Southport Railway. — Owing to the increased traffic, it has been found necessary to increase the length of the trains to five cars each. The additional cars are not provided with motors. All perplexities as to irregularity have now been removed, the entire electric service running most promptly and sweetly, and the system of frequent expresses between Southport and Liverpool and *vice versâ* is of immense service to residents and visitors at both termini.

London.—CITY.—At the meeting of the Court of Common Council on Thursday last week there was a lengthy discussion on a motion by Mr. H. Dixon Kimber, to the effect that the opposition to the London County Council Bill "during its remaining stages through Parliament" should be undertaken by the Bridge House Estates Committee, with authority to confer with the Streets Committee and the Special Committee. Mr. Barber seconded the motion. Mr. A. Morton, the chairman of the Streets Committee, said that the decision of the Committee of the House of Commons really meant that the Corporation had a veto on the matter. He contended that the tramways were not required. After further discussion, an amendment moved by Mr. Lile, and seconded by Mr. Neal, that the matter should go to the Special Committee, with power to confer with the Streets and the Bridge House Estates Committees, was carried.

L.C.C.—The Council on Tuesday decided, after discussion, to sanction an expediture of £287,000 for the construction of the new tramways referred to in the last issue of the REVIEW.

The Highways Committee brought forward the accounts of receipts and expenditure in connection with the tramways for the year ended March 31st, 1905. With regard to the southern tramways worked by the Council, the accounts are as follows:—

	Electric traction.	Horse traction.	Total.
Total receipts ...	£548,296	£133,799	£682,095
Working expenses...	365,498	134,328	499,825
Surplus on working	£182,798	—£529 Deficiency.	£182,269

After providing for debt charges amounting to £136,954, and £3,261 for income-tax, and placing the sum of £35,000 to the renewals reserve fund, there remains a net surplus of £7,054, which has been carried to the appropriation account. This compares with a net deficiency of £8,283 in 1903-4, when nothing was set aside for renewals. The working expenses of the two systems in the past year were as under:—

WORKING EXPENSES PER MILE RUN.

Horse traction	10·23d.
Electric traction	8·03d.
Difference in favour of electricity	2·20d.

The figure of 8·03d. per car-mile includes expenditure in connection with the provision of temporary generating stations and other special items, but, excluding these, the total operating expenses for electric traction were 7·49d. per mile. This rate is expected to be largely reduced when the power station at Greenwich is completed. In the case of the lines leased to the North Metropolitan Tramways Co., the accounts showed net receipts of £58,938, which, after meeting debt charges, leaves a surplus revenue of £22,836 to be carried to the appropriation account. The final result is a balance of £29,998 to be carried forward in the accounts for the present year.

The Council formally postponed the consideration of a recommendation in favour of the expenditure of £12,500 for the acquisition

of a site for the erection of a car-shed at Poplar in connection with the working of the northern tramways.

An expenditure of £8,850 was sanctioned for the purchase of five additional induction motor-generators from Messrs. Dick, Kerr and Co. for sub-stations at Battersea and Wandsworth.

The Highways Committee, in reporting on the completion of the tramway subway between Southampton Row and the Strand, announced the intention of bringing forward, after the vacation, a report in respect of the trackwork and other incidental works for the tramway.

Lewisham.—The B.C. has received a communication from the L.C.C. to the effect that the new line of tramways from High Street, Lewisham, to Lee Green, will be constructed as soon as the street widenings along the route have reached a sufficiently advanced stage.

New Zealand.—Auckland.—Mr. P. M. Hansen, of the Auckland Electric Tramways Co., has written to the C.C. pointing out that the construction of the foundations, &c., of Queen Street is very defective, and asking whether the Council will take the repairs in hand or recoup the company for the same. Repairs to this thoroughfare appear to be repeatedly in hand, and from our local correspondent we learn that the company is endeavouring to remedy the trouble by driving blue-gum piles for a depth of 21 ft. into the road bed, at which depth a solid foundation is reached. Over these piles the usual material for the rail bed is to be placed, and the whole covered with Neuchatel asphalt. The cost of this work will be considerable.

Christchurch.—The tramways contractors to this municipality have been damaging the roads by heavy traction engine traffic. The C.C. intends to make the contractors pay for the repair of these, and estimates the sum necessary to repair the Papanui Road at £2,000.

Penge.—The British Electric Traction Co. and the Penge Council have now signed an agreement superseding the previous agreements. The new terms stipulate that the extension from the Croydon border shall be completed immediately, and that the whole of the lines completed shall be opened by April 1st, 1906. The company is to pay to the Penge Council 1 per cent. on the capital outlay, and in addition the sum of £6,100 for widenings, &c. A 32 ft. road is to be provided by the Penge Council with a double track, and this is to be maintained and kept in repair by the Penge authority at fixed rates per mile. The extension will run from the Croydon border at South Norwood to the Penge entrance of the Crystal Palace, and there will also be a junction which will run from Croydon Road along the Anerley Road up the steep gradient to the Low-Level entrance of the Crystal Palace.

St. Helens.—It would seem that the strike of the tramway workers at St. Helens is practically at an end, the service being now maintained on all sections; and even in the colliery districts of Haydock and Parr, where a good deal of hostility was anticipated, there has been no interference with the running of the cars. The prompt action of both the county and borough police has had a good deal to do with this. The street processions have been stopped by the police authorities. Some of the strikers have gone back to work, and others have made application for their old situations.

The men remaining on strike are in receipt of strike pay from the Tram-men's Union, and contributions from the local trade unions have resulted in an increased grant being made this week to both the married and the single men.

Owing to the tramway shed having to be cleared in preparation for the Chamberlain demonstration on Saturday, the bulk of the cars were allowed to stand in Corporation Street on Thursday and Friday nights. They were lighted up and guarded by police. No attempt was made to damage them.

On Thursday last week a grave charge was made against the tramway workers on strike by Chief Constable Ellerington, who handed to the Bench a small parcel of pieces of iron, and said something would have to be done, as these things had been found in the various points up and down the tramlines.

The Chief Constable then handed to the magistrate a small tin of chlorate of potash, and said the explosive was found on the tramlines in Shaw Street, and was sufficient to destroy the motor if it had struck the car where it was anticipated it would. He said he had not been able to bring it home to any of the strikers, but every time such things had been found the tramway men on strike had been seen in the immediate neighbourhood, and had been seen running away after the explosions had occurred.

The Chief Constable added that from information in his possession he had no hesitation in saying that the obstructions and explosives had been placed on the line by the tram-men out on strike, and nothing had been done by outsiders. Some innocent person might be killed, if drastic measures were not taken to prevent a recurrence of that dangerous proceeding.

At the same court, Thomas Bailey, a tramway striker, was charged with resisting the police. An explosion had occurred under a tramcar, and a policeman arrested a man whom he suspected of placing the explosive there. It was alleged that the man Bailey interfered with the constable, with the result that the prisoner got away. The magistrates imposed a fine of 20s. and costs.

The tramway workers on strike indignantly deny the Chief Constable's charge that they are in any way responsible for the explosives which he produced. They declare that they are most careful not to prejudice their case by any act of violence.

Warrington.—An extension of time for completing the electric tramways has been applied for.

South Africa.—Johannesburg.—It is stated that an agreement with the T.C. has just been signed ensuring an electric tramway service through the Kensington Estate as soon as the Corporation can complete the necessary construction work.

Walthamstow.—On Saturday last the U.D.C. light railway undertaking was formally opened by Councillor C. J. Wilkes. A large number were present at the ceremony, and after congratulatory remarks, a brief outline of the scheme was read by the town clerk, special cars were boarded, and the visitors were conducted over a portion of the routes. On returning to the car depôt light refreshments were partaken of. The system comprises three routes with a total length of about 9 miles. The conductors are overhead, with side bracket and span-wire suspension. An extensive depôt, together with the light railway offices, has been erected in Chingford Road. The number of cars at present provided is 32, and they are of the single-truck, double-deck type. The contract for the whole of the work was let to Messrs. W. T. Henley's Telegraph Works Co., who sublet the track work and overhead equipment to Messrs. Dick, Kerr & Co.; the additional generating plant, &c., to Messrs. F. Suter & Co.; and the rolling stock to the British Westinghouse Co. The management of the system is in the hands of the Council's electrical engineer, Mr. J. H. Fooks Bale, and the consulting engineer to the scheme is Mr. James Enright.

York.—At the meeting of the T.C. on Monday, a letter was read from the Tramways Co. asking for the Council's consent to the company working tramways by electricity and to the extension of the system. It was decided to reply that it was the intention of the Committee in due course to recommend the Council to purchase the existing tramways at the expiration of the next septennial period.

TELEGRAPH AND TELEPHONE NOTES.

Mauritius - Réunion Cable.—The French Under-Secretary of State for Posts and Telegraphs announces that an agreement has been concluded between France and Great Britain for the laying of a cable between Réunion Island and Mauritius. The work on the Réunion-Mauritius and Mauritius-Madagascar cable will very shortly be taken in hand.

Newfoundland Telegraphs.—The Government is about to introduce into the Legislative Assembly a Bill imposing an annual tax of $4,000 each on telegraph cables landing on the island, 1 per cent. of the traffic receipts on landlines, $4 each on telephones, and $4,000 each on wireless telegraph systems, if doing commercial business, but nothing while merely reporting ships.

Pacific Cable Conference.—The first sitting of this Conference, which has been postponed from time to time, is to be held at the Colonial Office on the 21st inst. Sir William Mulock, P.M.G. of Canada, will represent the Dominion, while Lord Jersey will represent the Australian Commonwealth, and Sir Sandford Fleming New Zealand. The agreements between certain of the Australian States and the Eastern Extension Telegraph Co. will be discussed, and various working and financial questions connected with the Pacific cable will also be dealt with.

Shanghai Telephones.—The sixth annual ordinary meeting of the Shanghai Mutual Telephone Co., Ltd., was held on April 5th, when the accounts, which showed a profit of 76,937 taels, were passed. At an extraordinary meeting, held subsequently, it was resolved to increase the capital of the company by the creation of 13,000 new shares of 50 taels each, in addition to the 7,000 like shares already existing. The present exchange accommodates 2,500 subscribers, and the apparatus is to be increased to deal with 5,000.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
St. Lucia-Martinique	May 7, 1902	
Dominica-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostok-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Bathurst-Bissao	April 22, 1905	
San Domingo-Curacao	May 5, 1905	May 19
Dakar-Conakry	May 11, 1905	
Paramaribo-Cayenne	May 25, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutehoum	Sept. 27, 1904	

Telephone Employés' Union.—The engineering, construction, clerical and maintenance staffs of the National Telephone Co. have formed themselves into the National Society of Telephone Employés.

Telephone Work at Portsmouth.—In last week's Parliamentary questions, there was one by Mr. Gibson Bowles, asking the Postmaster-General whether extensive electrical works were carried out by the Post Office in Portsmouth Dockyard between May and September, 1904; if so, for what purposes were these works undertaken; what was the total cost of them; what was the total amount of wages expended on the works; how many men were employed thereon, and for how many days; and what overtime was paid for? Lord Stanley, in reply, said that extensive

telegraph works were carried out in Portsmouth Dockyard by the Post Office engineering staff during 1904 and the early part of this year. The purposes were, to reconstruct on modern principles the telephone systems of the Admiralty and War Department, and to render communication more rapid and more efficient. The total cost was about £7,500.

Wireless Telegraphy in France.—The French Thomson-Houston Co. announces that the Ateliers Thomson-Houston have acquired for France and the French colonies a licence for the wireless telegraph patents on the Braun-Siemens and Slaby-Arco systems which have been united by the Berlin Co. for wireless telegraphy under the title of the Telefunken System. The arrangement with the German Co. was entered into a few months ago, and the company has since then established a repairing shop at Shanghai for ships equipped on this particular method, while a second shop is to be provided at Kiao Chao.

CONTRACTS OPEN AND CLOSED

OPEN.

Aston Manor.—June 23rd. Electrical equipment of trolley tramways for the Corporation. See "Official Notices" to-day.

Belgium.—June 23rd. Tenders for an installation of electric lighting in the Posts and Marine Department in the Rue Ducale, Brussels. Particulars for 1 fr. from, and tenders are to be sent to, La Direction Generale des Ponts et Chaussées, 38 Rue de Louvain, Brussels.

Darlington.—June 19th. Switchboard extension and booster for the Corporation. See "Official Notices" June 2nd.

Fulham.—Tenders are to be invited by the B.C. for mains extensions, estimated to cost £1,550.

Gravesend.—June 14th. The Education Committee invites tenders for the electric lighting of Church Street Council Schools. Specification on application to Mr. C. F. McInnes, Electricity Works, Gravesend.

Grays Thurrock.—June 17th. Storage battery, feed pump, switchboard and economiser extensions, for the U.D.C. See "Official Notices" June 2nd.

G.W. Railway.—June 28th. Pipe-work, pumps, feed-heaters, and other plant for Park Royal generating station. See "Official Notices" to-day.

Hornsey.—June 19th. Side-arm brackets and switch-boards for arc lighting. See "Official Notices" to-day.

Hull.—June 22nd. One 500-KW. high-tension and one 500-KW. low-tension, continuous-current high-speed generating sets; also six Lancashire boilers with downtake superheaters. See "Official Notices" to-day.

Leigh.—July 1st. One water-tube boiler. See "Official Notices" to-day.

Manchester.—June 14th. L.T. cables; amp.-hour and watt-hour meters; box compound. See "Official Notices" June 2nd.

Melbourne.—July 14th. Arc lamps, poles, brackets, &c., for street lighting for the Council. See "Official Notices" May 12th.

Ossett.—June 14th. High-speed engines, dynamos, booster and balancers, battery, switchboard, crane and cables. See "Official Notices" May 26th.

Spain.—July 5th. The municipal authorities of Mazarron are inviting tenders for the concession for the electric lighting of the town during a period of 30 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Mazarron.

Whitchurch Asylum.—June 14th. Electric lighting installation for the Asylum Visiting Committee of the Cardiff Corporation. See "Official Notices" June 2nd.

CLOSED.

Battersea.—The Lighting Committee has provisionally accepted the following tenders:—

Electric Construction Co., Ltd., additional switchboard panel, £610.
Messrs. J. P. Hall & Sons, Ltd., compound direct-acting boiler feed pump, capable of lifting 6,000 gallons pe hour £148.

Bolton.—The T.C. has accepted the tender of Messrs. J. Musgrave & Son, for the supply of two Lancashire boilers to the E.L. works, and that of the Triumph Stoker Co., Ltd., for two stokers.

Bradford.—The T.C. has accepted the tender of Mr. A. E. Dean for the supply of electrical fittings, at £126 10s.

Croydon.—The Croydon County Council, on Monday, accepted the tender of Messrs. W. J. Bishop & Co. for installing electric light at the Central, South Norwood, and Thornton Heath Baths, at £170. Nine firms tendered, and the highest amount was £317, quoted by Messrs. Wenham & Waters, Ltd.

Fulham.—The Lighting Committee has provisionally accepted the following tenders:—

General Electric Co., Ltd., 100 3-ampere meters, £187 10s.; 50 10-ampere meters, £98 15s.
British Thomson-Houston Co., Ltd., 100 5-ampere meters, £187 10s.; 25 30-ampere meters, £50; 10 50-ampere meters, £24 6s. 8d.; 10 75-ampere meters, £28 6s. 8d.; 5 100-ampere meters, £15 16s. 8d.
Messrs. Redpath, Brown & Co., steel roof and coal-bunkers at generating station, £2,442 13s. 2d.
Messrs. Westwood & Wrights, Ltd., construction of condenser pipe, sump and river work, £4,314.
Messrs. E. Green & Sons, Ltd., moving existing economisers, and constructing two new ones, £624.

Gloucester.—In connection with the extension of plant at the Electricity Works, the T.C. has accepted the following tenders:—

Messrs. Easton, Anderson & Co., Ltd., three superheaters, £260.
Messrs. E. Green & Sons, Ltd., economiser section and alterations to pipe-work, £159.
Messrs. Belliss & Morcom, Ltd., alterations to Belliss engines, £41 10s.
Messrs. Willans & Robinson, Ltd., alterations to Willans engines, £17 12s.
Messrs. De Grelle, Houdret & Co., arc lamp carbons at schedule prices.

Halifax.—The tender of the British Insulated & Helsby Cables, Ltd., for the supply of 2,901 yards of tramway feeder to be laid from the electricity works to King's Cross, Halifax, has been accepted by the Electricity Committee.

Hammersmith.—The following tenders have been received by the B. of G. for electrical machinery and for installation and wiring at the Workhouse:—

	Installation and wiring.	Machinery.
Jackson Bros.	£4,286	£1,084
Fryer & Co.	4,590	1,061
Coates & Son	5,250	1,063
Marshall & Co.	5,498	2,900
W. Winn	5,713	1,237
R. Brightwell	5,715	1,435
Scott Anderson	5,780	1,454
Lea & Warren	6,455	1,245
Private Wire & Telephone Co. ..	6,928	1,636
Potter & Sons, Ltd.	7,351	934
Coleby & Co.	7,650	1,500
Alliance Electrical Co.	8,654	912
Suter & Co.	8,986	1,175
D.P. Battery Co.	—	926
Witting, Eborall & Co.	—	968
Morley Electrical Co.	—	994

Heywood.—The T.C. on June 1st accepted the following tenders in connection with the electrification of the tramways:—

Mr. S. Barker, Heywood, buildings.
Messrs. T. Hill & Sons, Heywood, boilers, &c.
Messrs. Dick, Kerr & Co., Ltd., Preston, engines, &c.
Messrs. Ferranti & Co., switchboard, &c.
British Insulated & Helsby Cables, Ltd., cables.
Messrs. Blackwell & Co., Ltd., permanent way and overhead equipment.

Islington.—The B.C. has given a contract to the Union Electric Co., Ltd., for 42 "Excello" flame lamps, at £389.

London.—The following tenders have been received by the London County Council for the roadwork and platelaying in connection with the construction or reconstruction of tramways (1) in Greenwich, (2) New Cross and Lewisham and (3) from High Street, Lewisham to Rushey Green:—

Name of firm.	Tramways work (exclusive of Woolwich Road lines.)	Paving works for street widenings.	Total.
Dick, Kerr & Co., Ltd. (accepted)	£98,870 5 1	£4,558 10 6	£103,428 15 7
Krauss & Son, Bristol ..	101,607 5 7	4,532 2 10	106,039 8 5
J. G. White & Co., Ltd. ..	101,764 0 8	5,882 18 1	107,646 18 4
R. W. Blackwell & Co., Ltd.	103,282 7 2	5,277 12 9	108,559 19 11
J. Mowlem & Co., Ltd. ..	104,334 8 7	4,925 19 7	109,260 2 2
E. Nuttall & Co., Manchester	105,617 15 7	5,345 11 3	110,963 6 10
W. Griffiths & Co.	109,675 18 9	4,856 1 1	114,531 19 9
Pearson & Co., Ltd. ..	112,598 10 0	6,014 17 6	118,613 7 6
G. Hay & Co., London ..	Incomplete tender.		

The tender of Messrs. Tamplin & Makovski is recommended for acceptance, at £115, for the wiring of the new fire brigade station in course of erection at Wapping.

Newport (Mon.).—For a mechanical stoker for the new boiler at the power station the tender of the Underfeed Stoker Co., at £197, has been accepted; also that of Mr. Fabius Henrion for carbons.

River Plate.—The New Century Arc Light Co., Ltd., has received an order from the River Plate Electricity Co., Ltd., for 320 double carbon arc lamps and accessories, for street lighting in La Plata.

Southwark.—The tender of Messrs. Spenser, Whatley and Co., for the supply of 4,500 tons of coal for the electric light undertaking, has been accepted at the following prices:—4,000 tons slack, 9s. 5d., 10s. 5d., and 10s. 8d. per ton; 500 tons Welsh peas, 16s. 4d. per ton. There were 27 tenders.

Shoreditch.—The B.C. has accepted the tender of Messrs. Richardsons, Westgarth & Co., at £199, for a feed water heater for the generating station.

Stoke Newington.—Messrs. Ferranti, Ltd., have received, through Messrs. Bruce Peebles & Co., Ltd., the order for the transformers required for stepping down the 10,000-volt three-phase current to supply the motor-generators for the electricity supply scheme. The ratio of transformation is 10,000 : 500; the transformers are oil cooled, and the total capacity is about 350 KW.

FORTHCOMING EVENTS.

To-day's Arrangements.—At 9 p.m. Royal Institution. Sir Wm. H. White on "Submarine Navigation."

Saturday, June 10th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting at Newcastle.

Wednesday, June 14th.—At 5.30 p.m. Chemical Society Meeting.

Friday, June 16th.—At 8 p.m. Physical Society. "On the Ratio between Mean Spherical and Mean Horizontal C.P. of Incandescent Lamps," by Dr. J. A. Fleming; "Electrical Conductivity of Flames," by Dr. H. A. Wilson; "Contact with Dielectrics," by Mr. R. Appleyard; "Pendulum Accelerometer, an Instrument for the Direct Measurement and Recording of Acceleration," by Mr. F. Lanchester; "Exhibition of a Refractometer," by Mr. R. Appleyard.

Tuesday, June 27th.—Municipal Electrical Convention.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders have been issued:—

Saturday, June 10th.—Efficients for Weymouth Camp Parade at Waterloo Station, 12 noon.
Monday, June 12th.—"A" Company. Technical Instruction, 7 p.m.
Tuesday, June 13th.—"B" Company. Technical Instruction, 8 p.m.
Wednesday, June 14th.—No Adjutant's Drill.
Thursday, June 15th.—Recruits and Non-efficients for Weymouth Camp Parade at Waterloo Station, 12 noon. "C" Company. Technical Instruction, 8 p.m.
Friday, June 16th.—"D" Company. Technical Instruction, 7 p.m.

WILFRID C. DUMBLE, Captain.
For O.C.E.E.R.E. (V.)

NOTES.

Institution Notes.—SOCIETY OF ENGINEERS.—On Monday a paper was read on "The Improvement of London Traffic," by Mr. Charles Scott Meik, M.I.C.E., and Mr. Walter Beer, A.M.I.C.E. The authors anticipated that the forthcoming report of the Royal Commission would deal with the needs of London in a comprehensive manner. The traffic conditions of London are unsatisfactory, and will become worse if means are not taken for their improvement. Considerable amelioration of existing conditions can undoubtedly be effected by an extension of the powers of the police and by the construction of local widenings, the electrification of suburban railways, and the completion of the tube lines, but more drastic measures are required to adequately relieve the present congestion and to provide for future expansion. They suggest that new main avenues should be made through London, and point out that they are supported in their views by the weight of evidence given before the Commission. The main avenues must tap existing centres of traffic and extend to the more distant suburbs. They must pass over or under all important cross streets within the central area, and should provide a special track for motor vehicles. Railways and tramways must be constructed along such main avenues, not only to assist in defraying their cost, but to enable the working-class population disturbed to be economically re-housed on the outskirts of London and to assist in providing for the ever-increasing demand for rapid passenger transport to and from the central area of the metropolis. The authors described the scheme laid by them before the Royal Commission last year and used it as a basis for the discussion of the general principles involved. Their chief proposals are for two main avenues through London from north to south and from west to east respectively. The north to south main avenue is designed to commence near Enfield and to extend through Tottenham, South Hornsey and Highbury, past the Parcels Post Office and Mount Pleasant, through Hatton Garden, across Holborn, the Strand, and the River Thames to St. George's Circus. Thence through Camberwell, Lambeth, and West Dulwich to the neighbourhood of Croydon. The west and east main avenue is intended to commence near Hounslow and to pass through Ealing, Acton and Notting Hill, Paddington and Marylebone to a junction with the north and south main avenue at Mount Pleasant. From Mount Pleasant this avenue would continue eastwards *vid* Liverpool Street, through Stepney, Bow Common and East Ham to the neighbourhood of Dagenham. These main avenues would together be 48 miles long, and for rather more than half their length they should be constructed with upper and lower roadways, the former passing over all cross traffic, and the whole design constituting a double-decked street. Each avenue would be 160 ft. wide, would provide a special road for fast motor traffic, a double line of tramway, and a double line of railway, the latter being situated either overhead, as in the case of the suspended railway at Elberfeld, in Germany; in shallow subway, immediately below the main avenues, or in tube at a greater depth. The earnings of the railways and tramways, calculated on the basis of zone fares varying from $\frac{1}{16}$th to $\frac{1}{8}$th of a penny per mile, would, the authors say, be sufficient to defray the expenditure on their construction as well as on that of the main avenues. Apart from the railways and tramways, the total cost of the 48 miles of main avenues suggested is placed at £21,311,000, which, it is estimated, could be repaid, with interest from the surplus earnings of the railways and tramways within a period of 40 years and upwards from the completion of the works, dependent upon the type of railway adopted.

SOUTH AFRICAN ASSOCIATION OF ENGINEERS.—At a recent meeting of this Association, a paper on "The Induction Motor as Generator," by Mr. T. P. E. Butt, was read. The writer gave a record of original work done at the Robinson Deep Mine in connection with the municipal electric plant.

ROYAL SOCIETY.—The following papers were read last evening:—Sir James Dewar, F.R.S., "On the Thermo-Electric Junction as a Means of Determining the Lowest Temperatures," and "Studies with the Liquid Hydrogen and Air Calorimeters"; Prof. J. A. Fleming, F.R.S., and R. A. Hadfield, "On the Magnetic Qualities of some Alloys not containing Iron."

Cricket.—A match between Siemens Bros. & Co., Ltd., Works Staff *v.* Westminster Staff on Saturday at Blackheath, resulted in a tie of 56 runs each after a most pleasant and enjoyable game.

On May 20th at Reading a match took place between the Town Hall and Electric Tramway Staffs. The latter were assisted by Mr. W. Binns (general manager) and Mr. A. G. Shearer (assistant engineer), and made 86 runs; the Town Hall Staff making a total of 45. Mr. Binns afterwards entertained both teams and visitors to tea.

Incorporated Municipal Electrical Association.—The programme of the annual meeting, which opens at Edinburgh on June 27th, has now been issued. The following is a list of the papers, &c.:—

Tuesday, June 27th, at Edinburgh.
North British Station Hotel.
Welcome by Lord Provost.
Presidential Address by Mr. F. A. Newington, city electrical engineer, Edinburgh.
Paper by Councillor Sinclair, Swansea Electricity Committee, on "Load Factor: Its Effect upon an Electricity Station."
Paper by Mr. E. E. Hoadley, chief electrical engineer, Maidstone, on "Street Lighting."
Visits to Dewar Place and McDonald Road generating stations.
8.30 p.m.—Reception by Lord Provost and Council.

Wednesday, June 28th, at Glasgow.
Welcome by Lord Provost of Glasgow.
Paper by Mr. Hamilton Kilgour, chief electrical engineer, Cheltenham, on "Notes on Costs and Tariffs for Electric Supply."
Paper by Councillor Hodgson, Salford Electricity Committee, on "The Supply of Electricity in Industrial Areas from a Municipal Point of View."
Luncheon given by Glasgow Electricity Committee.
Visits to Pinkston Power Station and Port Dundas and St. Andrew's Cross Electricity Works, also the Sub-stations at Waterloo and Dalhousie Streets, and the Power Station of the Clyde Valley Electrical Power Co. at Yoker.

Thursday, June 29th, at Edinburgh.
Paper by Mr. A. B. Mountain, chief electrical engineer, Huddersfield, on "Extensions to Outlying Areas."
Paper by Mr. A. R. Sillar on "Free Wiring and Supply on the Prepayment System."
Independent visits to places of interest.
Association Dinner (7.45 p.m.).

Friday, June 30th, at Edinburgh.
Annual General Business Meeting.

Saturday, July 1st, at Aberdeen.
Visits to the Electricity Works and Car Repair Depôt, &c., under the guidance of Mr. J. A. Bell, city electrical engineer.

Fuller particulars can be obtained from the secretary, Mr. C. McArthur Butler, Staple Inn Buildings, Holborn, W.C.

N.E.R. Motor-'Buses.—On Thursday last week, in the House of Commons, the North-Eastern Railway Bill was under consideration, as amended in Committee. An amendment was moved by Mr. Pemberton to prevent the railway company from running omnibuses in towns in competition with municipal tramways. Mr. Bonar Law pointed out that railway companies, which had to purchase the land over which their lines passed, were subjected to the competition of tramways laid on public roads, and paid for on the security of the rates, towards which the railway companies were the largest contributors. Moreover, when municipalities were promoting Bills to authorise the construction of tramways they declared that, owing to the greater cheapness of

tramways, motor-omnibuses could not compete with them; yet, when a railway company wanted to run motor-omnibuses, the municipalities said just the opposite! They were bound to see that competition was allowed on equal terms. It was beginning to be a question whether that House should direct the municipalities, or whether the municipalities should control the House. Eventually the amendment was defeated. The proposition that municipal enterprise should be allowed full liberty to compete with rival undertakings, but that the latter should be forbidden to compete with the former, is, on its face, ridiculous. Is sportsmanship extinct in this country?

Liège Exhibition.—We learn from a correspondent who, having been "had," is anxious to prevent others from being disappointed, that the Liège Exhibition is not yet half completed; no machinery is running, and the machinery hall is full of packing cases and trucks. The buildings are closed at dusk, apparently because the lighting arrangements are not ready, and one cannot obtain an official guide-book. Our correspondent thinks that the Exhibition will be well worth seeing in about eight weeks' time; at present, a visit would be only waste of time.

Steam Engines and Boilers Bill (Persons in Charge).—The introduction of a Bill to the House for licensing engine and boiler attendants seems to be a recurring affair, and we cannot think any good will come from it. The men in charge of engines and boilers trend to those employments by a sort of natural aptitude, and we fail to see that much good, if any, can arise from certificating such men, for we believe that many excellent men would suffer hardship as a result. The accidents to boilers in Great Britain are a mere fraction of those which occur in certificated, licensed and boiler-police-ridden America.

Appointments Vacant.—Assistants for the mechanical and electrical engineering departments at the Northampton Institute; assistant engineer for Glasgow telephone department; teacher for electric lighting and wiring for Enfield; shift engineer for Worksop (25s); science teacher for Lancaster Municipal Technical School (£160 to £200).

Electricity in Hospitals.—Under the heading "The Engineering Side of Hospital Work," a series of articles is running in the *Hospital*, and the author is now dealing with electrical apparatus. Unfortunately he does not appear to be too well equipped for his task. Dealing with electrical theories, he states that Hertz discovered that "electric waves pass in the ether," ignoring the work of Maxwell, whose theories were confirmed by Hertz. The author is presumably a "practical man," for he says that "the practical engineer must necessarily be the final judge of any theory, and that from his judgement there is no appeal." He goes on to say that the pure scientist too often "has a somewhat unhealthy contempt for facts," a statement for which there is as little justification as for the former. Emphasising the fact that electricity travels by every path that is "open" to it, and, therefore, through the insulating covering of conductors, the author states that some of the electric light and power engineer's most troublesome difficulties are due to leakage "through the insulating envelope;" this will be news to the said engineer. If there were no leakage but that through the insulating material, he would find it exceedingly difficult to detect any leakage at all, and certainly this leakage current would never give him sleepless nights. "The current that passes through the insulating envelope of the electric light and power cables, though small in quantity, is far from negligible, no matter how carefully the installation may be designed, and it has led, in several cases, to the deterioration of the envelope and the breakdown of the cable." These are the author's own words. The whole of the current passes "through" the insulation, in one sense—that is what the copper wire is there for; but it is the leakage over the surface, not through the substance, of insulating material that does the mischief. It appears that "contempt for facts" is not confined to the "pure scientist."

Electric Driving in Railroad Shops.—An article under the above title, from the pen of Mr. C. A. Seley, appears in the *Transport and Railroad Gazette* of May 26th, which, by the way, is printed in both French and English in parallel columns. It is satisfactory to note that the author recognises that the economy of transmission is one of the least of the advantages to be gained by electrical driving in a works of this description. The cost of the fuel used is, on the average, 3 per cent. of the cost of the article produced, the material costing about 50 per cent., and labour and other items about 47 per cent. It is obvious, then, that if the whole of the fuel cost was eliminated by electrical transmission, this saving would scarcely be a sufficient inducement to a manufacturer to turn out his mechanically-driven system in favour of electricity.

The multi-voltage system of working, which is used more in America than in this country, is described, although, as the author rightly points out, such wide variations as 1 to 10 in machine speeds are very rarely necessary. A range of 1 to 2½ or 3 covers most conditions. Such a range of speed as this can now be obtained by means of shunt-field control, which is, of course, the most economical method. There is very little that is new in the article, but the illustrations are interesting, these showing motors mounted directly on wheel lathes, punching machines and boring mills. The punching machine is driven by spur gearing, which, we should say, has not the flexibility given by a belt-drive, and must be very severe on both the motor and the gearing. Illustrations are also given of electrically-driven turn-tables and transfer-tables which are rather useful and interesting applications.

Excavation Relics.—We understand that the St. Helens Cable Co., whilst excavating on the Marylebone contract, have turned up considerable quantities of the old tree trunk water mains which were laid about 500 years ago, to supply the fountains in the city. These pipes have been found in the neighbourhood of Edgware Road Station, and are in most cases in a splendid state of preservation. One of the latest pieces of engineering in London streets thus meets relics of early enterprise.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.*]

Central Station Engineers.—The Electricity and Tramways Committee of Warrington T.C. has recommended the Corporation to increase the salary of Mr. J. Telfer, tramways manager, from £130 to £150 per annum; that of Mr. F. W. Purse, assistant electrical engineer, from £156 to £170 per annum; and that of Mr. W. E. Rogers, mains engineer, from £130 to £140 per annum.

Mr. Fredk. Vincent Lea Mathias, borough electrical engineer at Warrington, who was married on June 1st to Miss Frances Mary Houghton, has been presented by the Tramways and Electricity Department staff with a silver tea service and tray.

On June 1st Rochdale T.C. adopted the recommendation of the Gas and Electricity Committee to increase the salary of the electrical engineer, Mr. Atchison, from £250 to £300 per annum.

The position of electrical engineer and general tramways manager at Johannesburg, with a salary of £2,000 per annum, has been offered to Mr. A. A. Day, M.I.E.E., who holds a similar position at Bolton.

Mr. D. P. Tyson has been appointed clerk of works for the extensions to the Barrow Corporation electricity works, at £3 per week.

Tramway Officials.—Over 160 applications have been received by Keighley T.C. for the post of tramways manager.

The Southport Tramways Committee has recommended that the salary of Mr. J. T. Kendrew, manager, be advanced from £200 to £225, and later to £250 by two annual increments of £12 10s.

General.—Several references have already appeared in our columns to the intention of the Indian Government to appoint an electrical adviser. In the *Gazette of India* for April 29th just to hand, it is announced that Mr. J. W. Meares, electrical engineer to the Government of Bengal, has secured the appointment. The terms of the engagement are that the Bengal appointment ceases to exist, but that the Government of Bengal, in common with other Local Governments and Administrations, will be at liberty to consult him regarding any electrical schemes. Mr. Meares will rank as a superintending engineer of the Public Works Department, but he will not be prohibited from undertaking certain private work.

Mr. Chas. Lill, who has for some time been with Messrs. A. W. Penrose & Co., as technical manager of their electrical engineering department, has resigned his position with that firm, in order to join the Armorduct Manufacturing Co., Ltd., as engineer and technical manager of their power department.

Our readers will be pleased to learn that Lord Kelvin has so far recovered from his illness that he has been able to leave London with Lady Kelvin for Folkestone, to be away for a few weeks.

Mr. Ralph H. Covernton, who has returned to the Rand to resume his duties as manager of the Light and Power Works, after a holiday in Europe, was formally welcomed back by the employés, Mr. Frank T. Stokes acting as spokesman. Subsequently Mr. Covernton was presented with a gold watch, suitably inscribed, and a case of pipes. Mr. J. R. Henry, who acted as manager during Mr. Covernton's absence, was also presented with a silver cake basket and a case of pipes.

Mr. J. Cameron Lamb, C.B., C.M.G., Second Secretary to the General Post Office, who has retired after 42 years' service, was on Saturday, June 3rd, presented with a testimonial subscribed for by his many friends in the Department. The testimonial consisted of a handsome service of antique silver plate, an oak chair, and a ring (presented to Mrs. Lamb). The presentation was made by Lord Stanley, Postmaster-General, in the presence of a large assembly of Post Office officials, including Mr. Babington Smith (Secretary), Mr. J. Ardron, Sir Robert Hunter, Mr. J. Gavey (Engineer-in-chief), and Mr. Tremain (Controller). Lord Stanley paid a high tribute to Mr. Lamb's past services as telegraph secretary, and especially referred to the fact that Mr. Lamb had been present at five International Postal Conferences, and had presided at one. At these gatherings he had won the esteem of all the foreign representatives with whom he had come in contact. The Postmaster-General has appointed Mr. Buxton Foreman, C.B., and Mr. A. C. King to act as Joint Secretaries in the place of Mr. Lamb.

Obituary.—We regret to record the death of Mr. Marsh, assistant submarine superintendent of the Post Office at Woolwich. The deceased gentleman had served from his boyhood in the Submarine Telegraph Co., under the late Mr. Bordeaux, with whom he was transferred to the Post Office when it took over the Channel cables. Mr. Marsh, who was widely respected, was about 55 years of age at the time of his death, and he was buried at Dover last Saturday afternoon.

John Munro.—Our readers will learn with regret of the death of a man whose name has long been a household word among electrical men, because of his connection, as joint author, with one of the most widely-used of electrical works of reference. We refer to Mr. John Munro, of Munro and Jamieson

pocket-book fame. The first edition of that valuable pocket-book of electrical rules and tables appeared in 1884, and it has passed through many issues, until last year it reached its seventeenth revised edition. But beyond the multitude of engineers, students and others who knew him simply because of this work, there are still living many among our readers who knew him personally in the very early years—as we electrically count them—when electrical industry was but little more than a cradled babe. In those days after leaving Glasgow University, he had some connection with submarine telegraph cable laying and testing work, and was a frequent contributor to the electrical Press. Both then, and almost continuously since, he was a prolific writer as well for the popular reader as for the technical student. "Heroes of the Telegraph," "Electricity and Its Uses," "Pioneers of Electricity," "The Wire and the Wave," were the titles of some of a series of popular books which he produced for the Religious Tract Society, and which had an extensive scale. During the last few years many contributions from his pen have appeared in our columns, and it will be remembered that as recently as February last we published a signed article by him on "Wireless Telegraphy and the Empire," in which he advocated the establishment of "a chain of temporary or permanent stations for wireless messages . . . . throughout the Empire." For the "Science Notes" in one of our evening contemporaries he was also responsible, and these notes being written by a man of prolonged technical and general experience, who knew just how far to go in appealing to the popular taste without making himself ridiculous, were above the average as compared to a good deal of the modern halfpenny Press comment on scientific matters. He was also an inventor, being joint patentee of certain improvements in telephonic apparatus. According to reports that have appeared in the newspaper Press, he had for the last 10 years lived entirely alone at a small cottage in St. John's Grove, Croydon, and it was there that on Saturday last he was found dead at the foot of the stairs. He appears during his residence there to have studiously avoided exchanging words with anybody. The house is said to have borne evidences of poverty. An inquest was to be held this week, but the actual cause of death we have not yet been able to ascertain.

NEW COMPANIES REGISTERED.

Ozonair, Ltd. (84,770).—This company was registered on May 30th, with a capital of £5,000 in £1 shares (100 founders') to acquire inventions relating to the production, treatment, application, supply and generation of electricity and gas, or to apparatus therefor, in particular to acquire from E. L. Joseph the benefit of certain existing inventions relating to improvements in apparatus for ozonising, purifying, and otherwise treating atmospheric air, and to carry on the business of manufacturers of and dealers in galvanometers, ammeters, voltmeters, carbons, cut-outs, switches, motors, batteries and other electrical and gas appliances, &c. The first subscribers are:—E. L. Joseph, 27, Chancery Lane, W.C., electrical engineer, 1 share; T. S. Wederall, Balfour House, 119 to 125, Finsbury Pavement, E.C., chartered accountant, 125 shares; S. Gillatt, Balfour House, 119 to 125, Finsbury Pavement, E.C., chartered accountant, 125 shares; J. W. Burrows, 64, Thornhill Road, Barnsbury, secretary, 1 share; F. A. Austin, 29, Basinghall Street, E.C., surveyor, 50 shares; G. E. Mead, 21, Bishopsgate Street Within, E.C., stationer, 100 shares; and S. Rosenberg, 259, High Holborn, W.C., engineer, 1 share. No initial public issue. The number of directors is not to be less than three nor more than five; the first are E. L. Joseph, T. S. Wederall and S. Gillatt; qualification, 50 shares; remuneration as fixed by the company. Registered office, 27, Chancery Lane, W.C.

Everett, Edgcumbe & Co., Ltd. (84,764).—This company was registered on May 30th, with a capital of £20,000 in £1 shares (4,000 pref., 15,997 ord., and 3 "A"), to acquire the business of mechanical and electrical engineers carried on at Hendon, and at 87, Victoria Street, Westminster, as "Everett, Edgcumbe & Co.," to adopt agreements with E. I. Everett, K. Edgcumbe and G. J. Lemmens, and to carry on the business of mechanical and electrical engineers, instrument makers, electricians, suppliers of electricity, &c. The first subscribers (each with one ordinary share) are:—E. I. Everett, 87, Victoria Street, Westminster, engineer; K. Edgcumbe, 85, Victoria Street, Westminster, engineer; G. J. Lemmens, 85, Victoria Street, Westminster, engineer; E. C. E. Pinkerton, 20, Eastcheap, E.C., merchant; T. C. Lemmens, 20, Eastcheap, E.C., merchant; E. D. Moore, 18, Abingdon Street, S.W., solicitor; and W. J. Adlam, 10, Westmoreland Place, S.W., clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the first are K. Edgcumbe, E. I. Everett and G. J. Lemmens; qualification, £200; remuneration of first directors, £300 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Kent Electric Power Syndicate, Ltd. (72,742).—A charge on the company's undertaking and property, including uncalled and unpaid capital, to secure £1,850, has been registered. Date of charge: May 26th, 1905. Holders: The Hon. John B. Lubbock and G. C. Curtis, both of 15, Lombard Street, E.C.

Flather & Co., Ltd., electrical engineers, Leeds (74,602).—A second debenture, dated May 23rd, 1905, to secure £400, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: F. A. Angell, 16, Hillary Street, Leeds.

Harrington Electric Light Co., Ltd. (44,135).—This company's annual return was filed on May 11th, when 3,900 shares had been taken up and paid for in full out of a nominal capital of £5,000 in £1 shares. Mortgages and other charges: Nil.

Metropolitan Electric Supply Co., Ltd. (25,395).—This company's annual return was filed on April 12th, when 100,000 ordinary and 76,121 preference shares had been taken up out of a nominal capital of £1,500,000 in 100,000 ordinary shares of £10 each and 100,000 preference shares of £5 each. £10 per share has been called up on 97,968 ordinary and £5 per share on 76,121 preference shares, resulting in the receipt of £1,360,285. £20,320 is considered as paid on 2,032 preference shares. Mortgages and charges: £470,000.

ELECTRICITY SUPPLY ACCOUNTS.

Leeds Municipal Electricity Supply.

The returns of the Leeds electrical undertaking show that the greatly increased financial charges during the past year absorbed the whole of the gross profit. In order to meet sinking fund obligations, £1,000 was withdrawn from the redemption fund suspense account, and the balance, £282, is carried forward.

The undertaking is, however, in a very promising condition; the rapidly extending power load and increasing output having necessitated considerable capital outlay during the past two years, and with the very economical working costs attained at Leeds, the department will amply recoup themselves in the future.

The prices charged are:—Private lighting, 4d. and 1d. per unit, special scale; power, 2d. to 1½d.; and public arcs, 1½d. per unit, net. The chief engineer is Mr. H. Dickenson.

General Statement.

For year ending March 25th—	1905.	1904.
Total capital expended	£822,123	£757,327
Number of units sold—		
Private supply	4,871,731	4,428,657
Public lighting	217,997	177,170
Power and heating	1,940,953	1,665,359
Total number of units sold ...	7,030,681	6,271,186
Equivalent No. of 8-c.p. lamps connected	264,628	235,263
H.P. of motors connected	3,904	2,903
Number of public lamps	247 A	122 A
Maximum load in kw.	5,540	5,040
Revenue account—		
Gross revenue	£84,417	£75,720
„ expenditure	£28,364	£26,183
„ profit	£56,053	£49,537
Average price obtained per unit—		
Private supply and public lighting ...	3·47d.	3·48d.
Power and heating	1·34d.	1·28d.

Revenue Account for Year ending 1904-5.

Gross revenue	£84,417 =	2·86d. per unit.
Works and distribution costs (including public lighting)	£19,318 =	·66d. „
Total working costs	£28,364 =	·97d. „

Profit Statement, 1904-5.

Interest on loans	£23,809
Sinking fund	27,961
Contributed from redemption fund suspense account	1,000
Balance on year's working	283
Gross profit	£56,053

CITY NOTES.

Isle of Wight Electric Light and Power Co.

This company held its annual meeting at Ryde last Friday week, Mr. J. C. Wigham presiding. The report to December, 1904, showed that satisfactory progress had been made. The increases in lamp connections over the previous year were as follows:—

Ventnor and Bonchurch, 15,346 to 16,794; Sandown and Shanklin, 10,118 to 12,269; Newport and Cowes, 16,156 to 22,035; Ryde and St. Helens, 5,326 to 9,945. The result of the year's trading, including a balance of £345 brought forward from 1903, showed a profit of £7,544. After paying interest on debentures and loans (£4,700) and dividend on preference shares (£2,500), there remained a balance of £344. Of this the directors proposed to write off £200 from the preliminary expenses and to carry forward to next account the balance of £144. All the stations, being now completed and running, a comparatively small amount was expended on capital account during the year, and further expenditure will now only be necessary for extensions from time to time required. During the year the contracts for the public lighting of Shanklin and Bonchurch, and for the supply of current to the Royal National Hospital had been renewed. The profit and loss account showed that the payments amounted to £7,251, and the income had totalled £13,819. The amounts from the various towns to revenue account were as follow: Ventnor £2,386 13s., Bonchurch £123, Sandown £1,517, Newport £1,749, West Cowes £583, East Cowes £396, and Ryde £62.

The Chairman remarked that there was no declaration of a dividend, but the company had paid the interest on debentures and on preference shares, and they had also paid to the contractors a considerable sum by way of interest on the outstanding amounts due. The increase in the number of lamp connections throughout the island was gratifying. The sales had also shown good progress; whereas in 1903 the sales had totalled £6,700, in 1904 they had amounted to £9,800. Another pleasing item was that, whereas the capital expenditure of the company went up in 1903 by a very large sum indeed, the expenditure on capital account in 1904 was only about £13,000 distributed over the four stations. The renewal of the contracts for the public lighting of Shanklin and Bonchurch showed that they had satisfied their consumers.

The report was adopted.

The Chairman said that since the closing of the balance-sheet the contractors, Messrs. Edmundsons, had taken up £50,000 additional ordinary shares in the company.

India-Rubber, Gutta-Percha and Telegraph Works Co.

The half-yearly meeting was held at 106, Cannon Street, E.C., on Tuesday, Major L. Darwin presiding, for the purpose of obtaining the sanction of the shareholders to the payment of an interim dividend of 2½ per cent., or 5s. a share, free of income-tax.

The Chairman first paid a tribute to the memory of Mr. S. W. Silver, one of the founders of the company, and Mr. John Bailey, the late works manager, both of whom had died since the last meeting. He said that it was their custom to hold half-yearly meetings. No accounts were presented, but the board, judging from the general tendency of business during the period which had elapsed since the ordinary general meeting, had hitherto been able to recommend an interim payment. He was glad to say that they had had no difficulty in coming to that conclusion on the present occasion, and the meeting was called together to approve the distribution of the usual dividend of 2½ per cent. At the ordinary general meeting held in December last, he referred to the high price of raw material and to the almost insuperable difficulty of sufficiently raising the selling prices to meet the increase in cost of production so long as the advance was progressive. He also ventured to say that if the increase in cost reached a stationary stage, they would doubtless be able to get their selling prices advanced to a figure more commensurate with the actual cost of production. Since the meeting, that state of things had more or less been arrived at. Raw material was still very high, but the advance had not been progressive to anything like the same extent as it was previously, and they had been able to increase their selling prices, if not to the point at which they should be, yet sufficiently for their protection. Their cable steamers *Dacia* and *Buccaneer* had been employed in cable repairing work; the former had successfully laid a cable in the West Indies, and the *Buccaneer* was away from her home station laying short cables for the Dutch Government. In the recent eliminating trials in the Isle of Man the winning car was fitted with this company's tires. The works at Silvertown and Persan were busily engaged, and at the latter place they were incurring expenditure with a view to increasing the manufacturing facilities.

Lieut.-Col. Weston Jarvis seconded the motion approving the interim dividend, and it was carried unanimously.

In acknowledging a vote of thanks, the Chairman said that they met under happier circumstances than on the last occasion.

Prospectuses.

The Sir Hiram Maxim Electrical Co., Ltd.—This company is, through the Peddie Small Arms Corporation, Ltd., inviting applications for an issue of 15,000 6 per cent. £1 preference shares. After the ordinary shares have had 6 per cent. dividend, the surplus profits will be applied in payment of a further 4 per cent. on the preference shares and the balance for ordinary dividend. The company, as announced on page 779 of our May 12th issue, has been formed to acquire from the Peddie Small Arms Corporation, Ltd., the business and property recently acquired from the Sir Hiram Maxim Electrical and Engineering Co., Ltd. The present issue is to provide the cash purchase price, expenses of formation, and "sufficient working capital." The purchase price is £23,000, payable as to £3,000 in cash, and the balance in 20,000 ordinary shares of £1 each. The purchase price includes £9,500 for goodwill, £7,000 for patents, propriety rights, &c., and £6,500 for stock, plant, machinery, &c. No doubt some of our readers will wonder with us whether a company which wound up because it could not meet its liabilities has a goodwill that can be considered of any value to transfer to a new company that may be formed to bring it to life again.

British Aluminium Co., Ltd.—This company has this week been making an issue of £300,000—5½ per cent. Loch Leven mortgage debentures, and 38,000 ordinary shares of £5 each at par. The money is needed in connection with the Loch Leven water power development scheme, particulars of which have already been published in these columns. The list was to close yesterday, Thursday.

The Newcastle and District Electric Lighting Co., Ltd., is inviting subscriptions at par for £150,000 of 4½ per cent. mortgage debenture stock. The lists will close to-day.

Stock Exchange Notices.—The Committee has ordered the undermentioned securities to be quoted in the Official List:—British Westinghouse Electric Manufacturing Co., Ltd.—Further issue of £400,000 4 per cent. mortgage debenture stock. Application has been made to the Committee to allow the following to be quoted in the Official List:—City of Wellington Electric Light and Power Co., Ltd.—£75,000 5 per cent. registered first debentures of £50 each, Nos. 1 to 1,500. (Renewed application.)

United Electric Tramways of Monte Video.—Mr. W. Trotter, in presiding at the first ordinary meeting of this company held at Winchester House on Monday, said that the net receipts of the Sociedad Comercial de Monte Video had fallen because of the revolution, but things were now greatly improved; indeed, during the first six months of the year there had been a net increase of £4,481. After paying 6 per cent. dividend, £147 remained to be carried forward. The lines, including extensions, which were to be electrically equipped, were altogether 51 miles.

STOCKS AND SHARES.

Wednesday Evening.

Whitsuntide holidays are supposed to be responsible for the lack of business that has irritated the Stock Exchange this week, but the coming of the recess is really subordinate to a much more valid reason for the quietude. The latter is due, more than anything else, to the continuance of the war. People say they prefer to wait before investing or speculating. The tide may turn rapidly, or it may take long to alter, and, therefore, public money is still shy of seeking Stock Exchange channels for investment. One week there is a little more, and the next a little less, business doing, and again the price-lists overleaf show by their steadiness the inactivity in the general volume of trade.

Their rise of 9 points make Amazon Telegraph 5 per cent. Debentures to stand out as a feature of the week. The advance is due, of course, to the resolutions passed at Tuesday's meeting for capitalising the interest. Full details of the proposals were given in our last week's issue. The last interest paid was in June, 1899, so that there are six years' unpaid coupons on the bonds, equalling 30 per cent. The company's shares have not moved from 2½, which is only one-fourth of their full nominal price, and it may be that some speculative attention will be turned to these after the rise in the Debentures.

Cuba Telegraph Preference are 10s. better again at 16½, and Eastern Ordinary continues to rise at the rate of a point per week. The price is now 142½. Eastern Extensions lag behind at 14. Of the other "war stocks," Great Northerns fell 10s. to 34, and those other heavy shares, Indo-Europeans, are a sovereign lower at 50. In the American division, Anglo "A" show ⅞ decline after their last week's rise. One or two Debenture stocks have put on small improvements.

After their sharp rise National Telephone issues have gone more steadily, but the Preferred at 111½ is the fraction to the good, and the Third Preference shares are ½ up at 5⅝. The opinion of the Secretary to the Post Office, given before the Commission, caused considerable satisfaction to those who feared the National Telephone undertaking might be taken over on tramway terms, and not those which govern electric lighting concerns. The Post Office evidently prefers the latter arrangement. Other Telephone changes are confined to a fall of $\frac{1}{16}$ in Orientals to $1\frac{3}{16}$, upon the new issue of Debenture stock.

Electricity Supply descriptions are exceedingly quiet. Charing Cross City undertaking shares of both kinds are at length ⅛ over their par price of 5, and Charing Cross Preference rose ⅛ to 5⅝. Urban Ordinary at $4\frac{15}{16}$ are a trifle easier, although the Preference remain at 5¼; St. James's fell ¼ to 14¼, and Kensington at 12 are ½ down. Since we have not mentioned the provincial shares for some time, it may be of interest to state that Oxfords are 6½, Hove 8, Bromley 5½, Folkestones 5½, and Bournemouth 11⅜. None of these have noticeably varied for weeks past, with the exception of Bournemouth shares, which have been 12. Kalgoorlie Electric Preference settled down to $\frac{13}{16}$, and Midland Electric Corporation 4½ per cent. Debentures have advanced to par.

Falling ⅛ to 1, Electric Constructions quickly lost their little improvement, but other manufacturing shares are uninteresting. British Aluminium First Debentures gained a couple of points at 102. There has been further weakness in Westinghouse Preference, and the shares are down to 2⅜, which is about ¼ higher than they were before the last brief rally that lifted them over 3 for a short spell. At 5⅜ Babcock & Wilcox are slightly better.

Railway securities appear unable to escape from their rut of sheer dulness. City and South London is not better than 41, and Great Northern and City Preferred "A" fell ¼ to 5. We are told that the contractors are well satisfied with the progress being made in receipts, but shareholders will view the decline in the price of the shares with different feelings. Districts have not changed, but Metropolitans fell a trifle. Baker Street and Waterloo Debenture is well supported at 101, equivalent to 5 premium above the issue price. Charing Cross and Strand 4 per cent. Debenture, with 25 per cent. paid, is being negotiated at about this price, and so is Great Northern, Piccadilly and Brompton Debenture.

Tramway varieties are somewhat firmer. British Electric Traction Ordinary at 11⅛ are ⅛ better, and London United Preference have ¼ rise to their credit at 10¼, the Ordinary also hardening to 11⅜. Barcelona Trams retain their strength at 13, and, as already suggested, the character of the buying lends colour to the theory that local authorities may be trying to obtain control. They have made several similar attempts before, but without success. Calcutta Trams at 8¼ are lower, but Cape Electrics at 1⅜ are without alteration, and the Argentine group is also featureless.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations May 31st	Closing Quotations June 7th.	Business done week ended June 7th, 1905. Highest	Lowest.
34,800	African Direct Telegraph, 4 % Debs.	100	4 %	4 %	4 %	99 —102	100 —103	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	2¼ — 2⅜	2¼ — 2⅜	2⅛	2 7/16
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	76 — 81	85 — 90	83	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	2½%	59 — 61	59 — 61	..	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝%	105 —106	105 —106	106	105⅛
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	15⅜ — 15⅝	15⅛ — 15⅜	15 9/16	15⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	..	6⅜ — 6⅝	6⅜ — 6⅝	..	..
15,000,000$	Commercial Cable	$100	8 %	8 %	8 %	..	..	..	..
1,932,856£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	4 %	4 %	4 %	97 — 99	97 — 99	98⅞	..
16,000	Cuba Telegraph	10	6⅛	10 %	5 %	8 — 8⅛	8 — 8⅛	8 7/16	8⅛
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	15⅛ —16⅛	16 — 17	16⅝	16⅜
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅜	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	8⅞ — 9	8⅞ — 9	..	..
30,000	Do. do. 4½ % Debs.	50	4⅓%	4⅓%	4⅓%	101 —103⅞	101 — 103	..	..
60,710£	Direct United States Cable	20	3½%	3 %	..	11⅛ — 11⅜	11⅛ — 11⅜	11⅜	11 5/8
78,500	Direct West India Cable, 4½ % Reg. Deb., within Nos. 1 to 1,200, Red.	100	4⅓%	4⅓%	4⅓%	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	140 —143	141 —144	142¼	141
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	..	91 — 93	90 — 92	92¼	91
1,836,814	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	107 —109	107 —109	108	107½
300,000	Eastern Extension, Australiasia, and China Telegraph	10	7 %	7 %	7 %	13⅜ — 14½	13⅜ — 14⅛	14⅛	13⅜
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	105 —107	105 —107	..	..
300,000	Eastern & South African Tele., 4 % Mt. Db., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	99 —101	100 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	100 —102	100 —102	101½	..
180,887	Globe Telegraph and Trust	10	£3 16 7*	5⅛ %	5⅛%	10½ — 10½xd	10⅛ — 10⅜	10⅜	10⅛
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14⅝ — 14½xd	14⅝ — 14⅝	14⅝	14 1/8
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	24 %	34 — 35	33½ — 34½	35	34¼
50,600	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	50 — 52	49 — 51	49⅞	49
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	..	⅞ — 1	⅞ — 1	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	110½ —111½	111 —112	112⅜	110⅝
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	103 · 105	103 — 105	105½	103¼
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12¼ — 13½	12¼ — 13½	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11⅛ — 12½	11⅛ — 12½	..	..
250,000	Do. do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5 7/8	5⅝
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 —102	100 —102	101⅛	100⅝
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103—105	103 — 105	105	103¼
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6⅛%	6⅛%	1⅜ — 1⅝	1⅛ — 1⅜	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	99 —102	99 —102	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	7⅛ — 8 xd	7⅛ — 8 xd	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	123—126	124 —127	125½	125
58,000	United River Plate Telephone	5	7 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	..	5 — 5⅛	5 — 5⅛	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	107 —109	108 — 110	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	8 — 8⅛	8 — 8⅛	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	Nil	Nil	Nil	⅜ — ½	⅜ — ½	..	..
150,000	West Coast of America, 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	100 —102	100 —102	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	13⅛ — 14	13⅜ — 14	14	13¾
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	101 —103	101 —103	..	..
563,380	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	103 —105	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	⅛ — ⅜	⅛ — ⅜	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	7 — 7⅛	7 — 7⅛	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	5⅝ — 6¼	5⅜ — 6¼	..	..
80,090£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	104 —106	104 —106	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	5 — 5⅛	5 — 5⅛	5 1/8	5⅛
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	4⅞ — 5⅛	4⅞ — 5⅛	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	2¾ — 3⅛	2¾ — 3⅛	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	98 —102	98 —102	101	..
133,301	British Electric Traction	10	8 %	6 %	..	9⅛ — 9⅞	9⅛ — 9⅜	9 3/8	9 1/16
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	..	11⅛ — 11⅜	11⅛ — 11⅜	11 1/16	11⅛
1,000,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	5 %	5 %	5 %	122 —124	122 —124	123⅜	122⅛
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	97 — 99	97 — 99	98⅛	98
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	5⅛ — 6	5⅛ — 6	5 7/16	5⅛
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	5⅜ — 6¼	5⅜ — 6¼	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	102 —105	102 —105	..	..
50,000	¶ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	13/16 — 14/16	13/16 — 14/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	1¼ — 1⅜	1¼ — 1⅜	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	92 — 95	92 — 95	94½	93¼
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	79 — 82	79 — 82	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10 — 11	10 — 11	10 9/16	10⅛
40,000	Do. do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5⅛ — 5⅞	5⅛ — 5⅞	5 5/8	..
300,000	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	107½ —109½	107½ —109½	109	107½
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	91 — 93	91 — 93	92¼	..
523,396	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	102	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	80 — 83	80 — 83	..	..
1,330,000	City and South London Railway	Stock	3½%	2⅜%	2½%	42 — 43	40 — 42	41⅝	41½
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	..	1¾ — 2⅛	1¾ — 2⅛	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	95 —100	95 —100	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	1¼ — 1⅛	1¼ — 1⅛	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	2 — 2⅛	2 — 2⅛	2	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	83 — 88	83 — 88	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	88 — 93	88 — 93	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	..	1 — 1⅛	⅞ — 1⅛	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	..	2¼ — 2⅜	2¼ — 2⅜	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	4 %	4 %	4 %	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9⅜ — 10⅛	9⅝ — 10⅛	10⅛	9⅛
200,000	Do. do 4 % Mort. Deb.	Stock	4 %	4 %	4 %	97 — 101	97 —101	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	11⅛ — 12⅜	11⅛ — 12⅛	12⅛	11⅝
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	5⅜ — 5¾	5⅜ — 5¾	5⅝	5 5/8
45,900	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	15⅜ — 16	15⅜ — 16⅜	..	..
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	100 —10 :	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1⅛%	1⅜%	1½%	3⅜ — 3½	3⅛ — 3⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	9¼ — 9⅝	9¼ — 9¼	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	33 — 35	33 — 35	..	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	103 —105	103 —105	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3⅛%	3⅛%	3⅛%	90 — 92	90 — 92	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 2½ per cent. (March 9th. 1905).

SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1902.	1903.	1904.	Closing Quotations May 31st.	Closing Quotations June 7th.	Business done week ended June 7th, 1905. Highest	Lowest.
29,377	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£5	8 %	10 %	10 %	9⅜—10½	9⅜—10½	10	9¹⁵⁄₁₆
10,623	Do. do. 7 % Cum. Pref. ..	£5	7 %	7 %	7 %	9½—10⅜	9½—10½	..	..
288,782	Central Electric Supply 4 % Guar. Deb. Stock	£100	4 %	4 %	4 %	103 —106 xd	103 —106	..	..
80,000	Charing Cross and Strand Electricity Supply	£5	10 %	8 %	8 %	7⅛— 8⅛	7⅛— 8⅛	..	..
80,000	Do. do. do.* 4½ % Cum. Pref. ..	£5	4½%	4½%	4½%	5⅝— 5⅝	5¼— 5⅜	..	..
40,000	Do. do. "City Undertaking" 4½ % Cum. Pref. ..	£5	4½%	4½%	4½%	4⅞— 5⅛	5 — 5⅛	5	..
40,000	Do. do. 1903	£5	..	4½%	4½%	4⅛— 5⅛	5 — 5⅛	5¹⁄₁₆	5
350,000	Do. do. 4 % Deb. Stock Red.	£100	4 %	4 %	4 %	106 —108	109 —111	..	..
44,436	*Chelsea Electricity Supply, Ord.	£5	4½%	5¼%	6 %	6⅛— 6⅝	6⅛— 6⅝	6⅝	..
150,000/	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	109 —111	109 —111	..	..
76,595	City of London Electric Lighting, Ord. 40,001—110,595.	£10	5 %	5 %	6 %	10¼— 11¼	10¼— 11¼	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£10	6 %	6 %	6 %	13¾— 14¼	13¾— 14½	..	..
400,000/	Do. 5 % Deb. Stock, Scrip, (iss. at 115) all paid	..	5 %	5 %	5 %	124 —128	124 —128	127	..
300,000	Do. 4½ % 2nd Deb. Stock, Prov. Certs., all paid	£100	4½%	4½%	4½%	104 —106	104 —106	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£10	4 %	4 %	4½%	8¼— 9	8⅜— 9	8⅝	8⁹⁄₁₆
30,000	Do. do. do. 6 % Pref., 40,001—60,000 ..	£10	6 %	6 %	6 %	12 — 12½	12 — 12½	..	..
400,000/	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	113 —116	113 —116	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	103 —105	103 —105	104	103¾
70,000	Edmundson's Electric Corporation, Ord. Shares	£5	7 %	7 %	..	5⅝— 6¼	5⅝— 6¼	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	..	6 — 6¼	6 — 6¼	6⅝	..
300,000/	Do. do. 4½ % 1st Mort Deb. Stock	£100	4½%	4½%	4½%	107 —109	107 —109	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£5	10 %	12 %	12 %	12 — 13	11½— 12½	12	11¾
136,000	Do. do. do. 4 % Debenture Stock ..	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	£3	Nil	Nil	3 %	2 — 2½	2 — 2½	..	..
60,000	Do. do. do. 6 % Pref.	£5	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	..
371,895	Do. do. do. 4 % 1st Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	99 —101	99 —101	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£5	7½%	8½%	10 %	9¼— 9⅜	9¼— 9⅜	9¼	9¼
76,121	Do. do. 4½ % Cum. Pref. 1—71,106, £3 paid ..	£5	4½%	4½%	4½%	5⅛— 5⅜	5⅛— 5⅜	5⅜	5¹¹⁄₁₆
220,000/	Do. do. 4½ % 1st Mort. Deb. Stock	..	4½%	4½%	4½%	109 —114	111 —115	..	..
250,000/	Do. do. 3½ % Mort. Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	98 —100	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	£100	4½%	4½%	4½%	99 —101	99 —101	100½	100
10,852	Notting Hill Electric Lighting	£10	6 %	6 %	7 %	14½— 15½	14½— 15½	..	..
59,000	Do. do. 4 % 1st Mort. Deb.	£100	4 %	4 %	4 %	100 —102	100 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£5	14½%	14½%	14½%	14 — 15	13⅝— 14½	14½	14
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£5	7 %	7 %	7 %	8¼— 8⅝	8¼— 9	..	..
150,000/	Do. do. do. 3½ % Deb. Stock Red. ..	£100	3½%	3½%	3½%	98 —100	98 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£5	2½%	4 %	4 %	2⅝— 3⅛	2⅝— 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	79 — 83	79 — 83	..	..
65,000	South London Electricity Supply, Ord.	£5	1¾%	3 %	4 %	3⅜— 4⅛	3⅜— 4⅛	..	..
100,000	South Metropolitan Electric Light and Power (Ord	£1	Nil	Nil	Nil	⅝— ¾	⅝— ¾	..	..
50,000	*(Late Blackheath and Greenwich* (7 % Pref.	£1	Nil	7 %	7 %	1¼— 1⅜	1¼— 1⅜	..	..
100,000	*Dist. E.L.Co.)* (4½ % 1st Deb. Stock	£100	4½%	4½%	4½%	105 —108	105 —108	..	..
30,000	Urban Electric Supply, Ord	£5	5 %	5 %	5 %	4⅞— 5⅛	4¹⁵⁄₁₆— 5¹⁄₁₆	..	..
30,000	Do. do. 5 % Cum. Pref.	£5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..
200,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	£100	..	..	4½%	104 —106	104 —106	105½	..
110,000	Westminster Electric Supply, Ord.	£5	12 %	13½%	14 %	12 — 13	12 — 13	12⅝	12⅜
28,151	Do. do. 5 % Cum. Pref.	£5	5 %	5 %	5 %	6 — 6½	6 — 6½	6	..

Shares not officially quoted :—Mackay Companies, ord., 39½—40. Pref. 73⅞—74½.

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

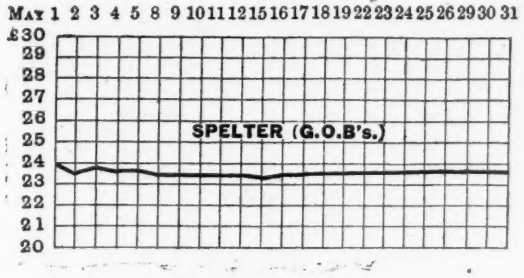
Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Miles open.	*
†Aberdeen	May 27	1,249	— 127	52	68,084	+ 5,290	..	..
Ayr	„ 27	556	— 4	2	600	+ 48	8	..
Bath	„ 31	1,438	— 24	22	13,394	+ 949	12½	..
Birkenhead	June 4	2,069	— 220	9	9,447	— 271	13·5	..
Blackburn	..	..	..	..	..	..	13½	..
Blackpool	„ 1	1,927	—1,406	9	6,392	— 1,431	8½	..
„ —Fleetw'd	„ 3	845	—1,532	22	6,223	— 1,408	..	..
† „ —Lytham	May 25	286	— 432	30	5,387	..	7½	..
Bolton	June 4	3,879	— 732	10	18,148	— 81	25	..
Bournemouth ..	May 31	2,060	— 350	8½	9,599	..	10·16	..
Bradford	June 3	8,609	— 934	9	39,406	— 2,393	53	..
Brighton	„ 4	1,961	— 121	10	8,823	..	9½	..
Bristol	„ 2	10,042	—1,332	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	May 26	415	+ 19	21	4,103	+ 49	..	..
Barnsley	„ 26	317	— 98	„	3,277	— 104	..	..
Barrow	„ 26	458	+ 96	„	4,279	+ 972	..	..
Birmingham (City)	„ 26	‡11,537	— 518	„	‡115,944	+ 6,014	..	..
Birmingham (Mid.)	„ 26	‡3,747	+ 43	„	‡36,814	+ 4,821	..	..
Devonport ..	„ 26	918	— 262	„	9,310	— 690	..	..
Dudley—Sto'rb'ge	„ 26	1,747	— 579	„	16,860	+ 103	..	..
Gateshead	„ 26	1,757	— 184	„	18,363	+ 288	..	..
Gravesend, N'fleet	„ 26	442	— 212	„	4,235	— 610	..	..
Gr'n'k, Pt. Glsgw	„ 26	1,508	+ 255	„	12,678	+ 1,761	..	..
Hartlepool ..	„ 26	473	— 264	„	5,098	— 368	..	..
Kidderminster ..	„ 26	224	— 148	„	2,068	— 228	..	..
Merthyr	„ 26	378	— 81	„	3,907	— 215	..	..
Metropolitan ..	„ 26	‡4,626	+ 1,515	„	‡43,637	+ 18,413	..	..
Middleton	„ 26	726	— 43	„	6,213	+ 440	..	..
Oldham — Ashton	„ 26	1,112	— 62	„	10,805	+ 73	..	..
Peterborough ..	„ 26	244	— 185	„	2,407	— 342	..	..
Poole	„ 26	575	— 117	„	5,238	— 283	..	..
Potteries	„ 26	3,289	— 339	„	34,466	+ 61	..	..
Rothesay	„ 26	259	— 12	„	1,531	+ 72	..	..
Sheerness	„ 24	130	..	„	1,241	+ 125	..	..
Southport	„ 26	610	— 263	„	5,426	— 424	..	..
South Staffs. ..	„ 26	1,399	— 455	„	14,078	— 1,093	..	..
Swansea	„ 26	1,611	+ 76	„	11,529	+ 1,134	..	..
Taunton	„ 26	96	— 27	„	926	— 124	..	..
Tynemouth ..	„ 26	437	— 323	„	3,990	— 911	..	..
Weston-s-Mare ..	„ 24	219	— 96	„	1,101	+ 31	..	..
Wolverhampton D.	„ 26	729	— 392	„	7,447	— 224	..	..
Worcester	„ 26	577	— 204	„	5,680	+ 689	..	..
Wrexham	„ 26	193	— 55	„	2,046	— 209	..	..
Yorks. Wool. Dist.	„ 26	1,250	— 196	„	12,400	+ 754	..	..
Burnley	June 3	2,161	— 132	..	..	..	..	..
Burton-on-Trent ..	„ 4	631	— 138	9	2,936	— 278	8½	..
Bury	May 28	1,335	..	8	5,457	..	..	..

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Miles open.	*
Cardiff	May 27	3,835	— 688	8	16,251	— 613	..	..
Carlisle	June 3	385	— 80	22	3,607	— 409	..	..
Chatham and Dist.	„ 1	1,261	— 41	22	13,225	+ 1,266	9·33	+ ·8
Colchester	May 31	370	..	44	9,366	..	18·75	..
Cork	June 1	1,057	+ 8	22	9,683	+ 435	9·9	..
Darlington	May 20	394	..	6	1,190	..	4·87	..
Darwen	June 2	481	+ 1	9	2,189	+ 41	4·96	..
Dover	May 13	394	+ 10	19	3,396	— 65	3	..
Dublin	June 2	10,340	— 937	..	102,175	+ 1,011	48½	+ 1½
Dundee	May 31	1,713	+ 2	..	..	..	..	..
East Ham	June 3	1,712	+ 81	9	7,460	+ 283	..	..
†Glasgow	May 27	15,524	+ 531	52	748,519	+ 40,771	78½	+ 3
Gloucester	„ 31	595	+ 24	8½	2,596	..	15	..
Halifax	June 3	3,392	+ 643	5	7,183	+ 209	35½	+ 2½
†Huddersfield ..	„ 3	1,401	+ 113	9	11,235	+ 135	..	..
Hull	„ 3	4,237	— 348	9	19,440	— 336	18	..
†Ilford	May 20	472	— 17	7	3,292	— 157	..	..
Ilkeston	„ 31	250	— 91	9	1,094	— 248	3·5	..
Ipswich	June 3	857	..	..	3,757	— 569	10½	..
Isle of Thanet ..	„ 3	1,042	— 445	22	7,494	— 571	..	..
Kirkcaldy	May 31	435	— 9	..	..	..	5½	..
Lan'kshire Trm. Co.	June 1	1,359	+ 33	22	14,364	+ 1,167	8·66	..
†Leeds	May 27	5,673	—1,306	9	51,312	+ 501	89½	+ 8½
†Leicester	„ 20	2,110	..	20	38,020	..	..	..
Liverpool	„ 27	21,216	— 512	21	213,220	+ 7,664	103	..
L.C.C.	„ 20	29,166	+ 7,127	3	100,182	+ 21,724	47½	+ 7⅝
Lowestoft	June 3	306	— 93	..	..	..	..	..
Manchester	„ 3	25,393	—2,164	9	114,537	+ 952	..	..
Newcastle	„ 3	7,365	— 375	..	..	..	..	..
†Newport	May 27	558	— 91	8	4,604	+ 599	14½	+ 1½
†Oldham	„ 28	1,596	+ 281	9	14,683	+ 3,625	53½	+ 5⅝
Plymouth	..	..	..	..	..	..	..	..
Pontypridd	June 3	307	..	9	1,566	..	3·75	..
Portsmouth	„ 3	3,682	— 609	9	16,819	— 898	14½	..
Reading	„ 1	1,190	..	9	5,372	— 247	19·12	..
Rochdale	„ 3	1,372	+ 1,029	9	5,384	+ 4,132	18·4	13·8
Salford	„ 5	8,731	— 731	10	39,716	+ 210	30	..
Scarborough	„ 3	209	..	22	1,725	..	8½	..
Sheffield	„ 4	9,870	— 353	10	48,113	+ 319	31½	+ 1½
Southampton ..	May 24	1,822	— 257	8	7,206	— 522	16·6	..
Southend-on-Sea ..	„ 31	687	— 82	9	2,784	+ 94	6½	..
†Stockport	„ 26	601	— 108	8	4,634	+ 174	11½	+ 1
Sunderland	„ 21	2,384	— 111	7	8,604	— 156	21	+ 1
Tyneside	„ 31	779	— 127	22	7,922	+ 1,020	..	..
†Warrington	„ 18	332	+ 29	7	2,272	+ 146	7½	..
West Ham	June 1	2,262	+ 959	9	13,259	+ 6,152	10·9	+ 6·4
Wolverhampton ..	May 31	1,491	— 70	9	6,610	..	..	..
Cen. London Rly.	June 3	13,330	— 89	22	153,716	+ 1,901	6	..
City & S. Lon. Rly.	„ 4	4,994	— 540	23	65,283	— 3,686	6½	..
Dublin-Lucan Rly.	„ 2	253	— 107	22	2,334	— 56	7	..
G. N. and City Rly.	„ 3	3,044	+ 1,200	22	34,699	..	3½	..
L'pool Overh'd Rly.	„ 4	3,058	— 333	22	34,482	— 1,829	6·75	..
Mersey Railway ..	„ 3	3,077	+ 222	22	35,155	+ 1,671	4½	..

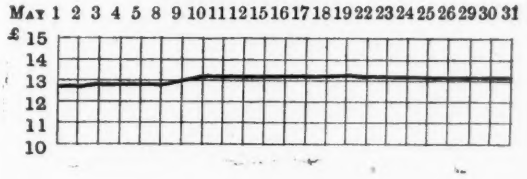
* Compared with the corresponding period of 1904. † One week only. ‡ Includes horse and other receipts.

METAL MARKET.

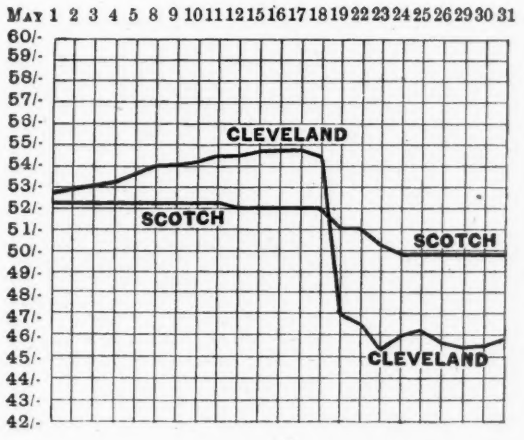
Fluctuations in May.



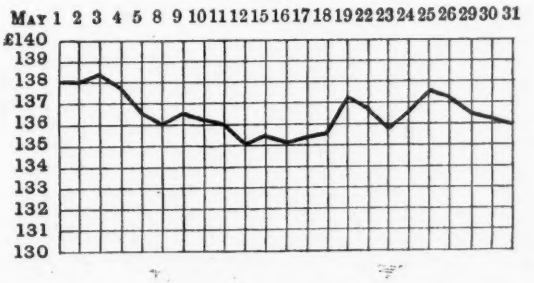
LEAD (ENGLISH).



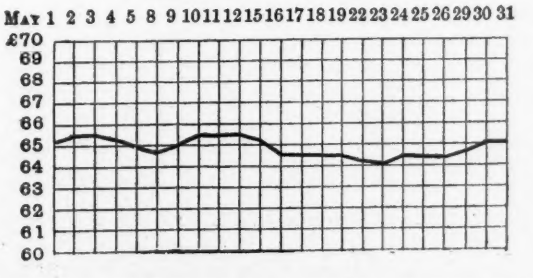
IRON.



TIN.



COPPER (G.M.B's.)



Stockton.—The Gas Committee of the Corporation has just completed the installation of new mechanical charging and discharging apparatus, which, with a range of new workshops, has cost the town £9,000. All the new machinery is actuated by electricity.

NEW TURBINE MOTOR-DRIVEN SINKING PUMP.

Messrs. Mather & Platt, Ltd., have recently constructed an entirely new form of sinking pump, the striking features of which are the limited dimensions and weight for the output which the pump is capable of giving.

Our representative recently witnessed a test, at the makers' works, of one of these pumps having a capacity of 500 gallons of water per minute with a maximum head of 300 ft. The accompanying illustration explains the construction of the apparatus.

Just below the four-way delivery pipe at the top is a four-pole totally enclosed motor, wound for 500 volts at a speed of 1,150 revolutions per minute, and having an output of 110 h.p., this being a large margin of power for contingencies beyond what is actually required for the specified output. The armature runs in vertical bearings, and is connected by a flexible coupling to the pump. A ball bearing at the top of the motor case takes the weight of the armature and spindle, and a similar bearing just above the pump takes the weight of the impellers and spindle.

New Sinking Pump.

Special arrangements are provided to allow of the pump going "on blast," *i.e.*, continuing to run while lifted clear of the water.

A distance piece between the pump and the motor forms a four-fold passage for the discharge of water from the pump. This four-way pipe is carried up between the motor poles, thereby saving space, protecting the pipes, and keeping the motor cool.

The four-fold pipe is carried up through the motor casing and terminates in one junction pipe at the top, attached to which is a sheave to take a wire rope for raising or lowering the pump in the shaft.

The overall length of the pump is 17 ft. 9 in., the greatest diameter 3 ft. 5 in., and the total weight 15·5 tons.

Messrs. Mather & Platt are at present manufacturing several pumps of this type, two sets being for the Dutch East Indies and one for the North-East Coast. This construction of pump marks a great step in advance of other types of sinking pumps hitherto employed, on account of its reliability, compactness, convenience, and economy, and there is every prospect of a wide field and successful future for its application to mining purposes.

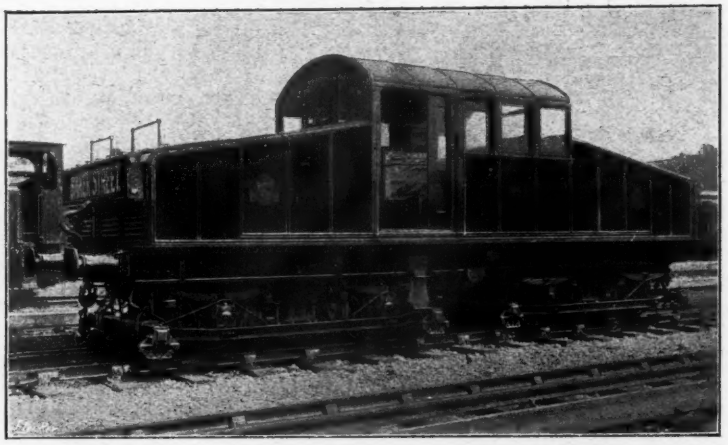
Leyton.—The U.D.C. has received from the B. of T. sanction to borrow £53,581 for the purchase of certain tramways in Leyton and Walthamstow.

ELECTRIC LOCOMOTIVE FOR THE METROPOLITAN RAILWAY.

The first of ten 50-ton electric locomotives has just been supplied to the Metropolitan Railway by the British Westinghouse Co. These will be used for hauling the main line trains between Harrow and Baker Street, the steam locomotive that brings them up from Aylesbury, &c., being taken off at the former point, and put on again there for the return journey. The trains used on this portion of the line are 120 tons in weight, and the new locomotives will propel them at a speed of 36 miles an hour.

The same locomotives will be used on the Metropolitan half of the Inner Circle for goods traffic, and for hauling the steam trains of other companies possessed of running powers over it. The electric locomotive will pick up the train at Edgware Road, being replaced by a steam locomotive when the train leaves the circle.

The new locomotives, one of which is shown herewith, will be equipped with four motors of 300 H.P. each; and a feature of interest is that, owing to the terminus facilities being somewhat restricted, it has been necessary to use motors of a smaller size than usual, equipped with forced ventilation, so as to keep down the length of the locomotives to convenient limits for handling at the termini.



British Westinghouse 50-ton Electric Locomotive.

DYNAMOS FOR JOHANNESBURG MUNICIPALITY.

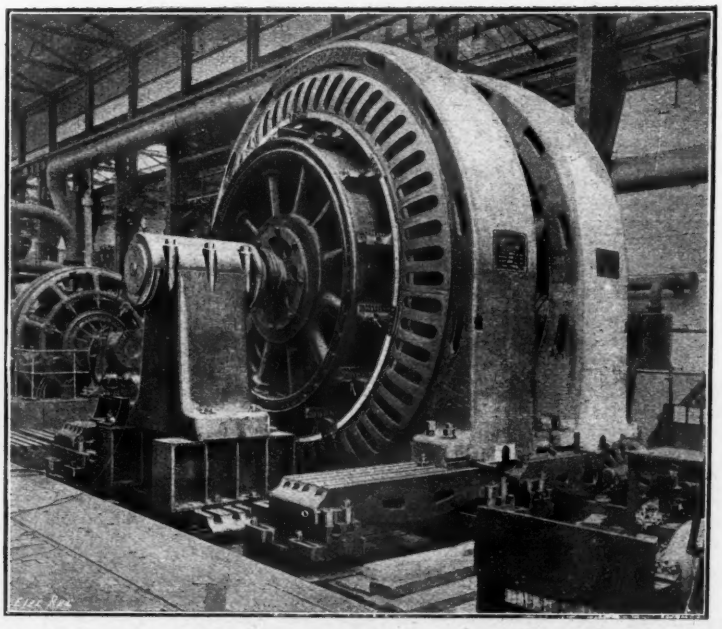
The accompanying illustration shows two large generators on the test bed at Messrs. Siemens Bros. & Co.'s Works at Stafford, in readiness to undergo the Hopkinson test. These machines, which are designed for the supply of lighting and traction, are of the Siemens 124.2H compound-wound 14-pole type, each arranged for direct coupling between the two cylinders, and bolted to the fly-wheel, of one of Messrs. D. Stewart & Co.'s 2,000-H.P. gas engines.

The rated output is as follows:—As shunt machines, 2,815 — 2,410 amperes, 480—460 volts, at 100 r.p.m. As compound, 0—2,250 amperes, 500—600 volts, at 103—100 r.p.m.

The armature is 10 ft. 4 in. in diameter. The armature coils are carefully insulated and inserted in the core slots under a special system, whereby high insulation and non-hygroscopic qualities are ensured, whilst the material used for insulation is specially tested under high voltage.

These dynamos form part of an order including generators having an aggregate output of 12,000 H.P., and consisting of:—Three dynamos, each of 1,350 KW.; two dynamos, of 675 KW. each; two alternators (two-phase), of 1,350 KW. each; and one alternator of 675 KW.

The machines are being built to the specification of Messrs. Mordey & Dawbarn for the Corporation of Johannesburg; they successfully passed through their tests, the efficiency being above the guarantee and the temperatures low, while the commutation at all loads was practically sparkless with fixed brushes.



Two Siemens 1,350-KW. Dynamos on Test-Bed.

THE DISTRIBUTING SYSTEM.

By "OMEGA."

Of all the various items which go to make or mar the success of an electricity supply undertaking, the distributing system is, without doubt, the most important. Of engines, boilers and dynamos, there is usually more or less reserve to fall back on, but there is only one set of mains. Thus, the recent litigation in which the Manchester Corporation has so unsuccessfully figured is of great interest to the whole of the electrical profession. On reading the report of this case, the question which seems to come most prominently to the fore is:—To what extent must the supply network of a large undertaking be divided? Now, in case of a bad short on the mains it cannot be denied that the advantages, consequent on the network being run in sections, deserve careful consideration, but again, these advantages may obviously be purchased too dearly. The B. of T. very rightly limits the variations of pressure at a consumer's terminals to 4 per cent. of the declared pressure. Now, obviously the best way to maintain steady pressures in face of the rapidly fluctuating loads, due to the large use of electricity for power purposes, is to thoroughly interconnect the whole system of mains and provide a liberal number of fair-sized feeders round the districts where the greatest fluctuations occur. Thus we are called on to decide whether to satisfy an ever-present condition that the pressure remain steady, by interconnecting the mains wherever possible; or provide against the possibility of the whole supply failing due to a short-circuit, a contingency which cannot be said to be unlikely, although with proper attention it should be somewhat remote. We think that anyone who has had to do with a large network will be

quite willing to forgo the pleasure of running the mains in "sections not exceeding 1,000 lamps," and prefer to give the consumers the benefit of steady pressure by interconnecting. Having got thus far, it will be well to inquire, To what extent are fuses desirable for interconnecting? The only answer which can be given to this question is that—in their proper place—fuses are excellent, but as part of a system of underground mains they are most emphatically out of place. Owing to the crystallising action which invariably takes place with alloys of tin, fuses of this material cannot be relied upon, and for a copper fuse to be any protection it must be run at a temperature which is altogether prohibitive. Further, the remedy is manifestly worse than the disease, for when anything serious happens on a large system of mains, then, if ever, is the time to know exactly how and in which way any district may be supplied, a state of affairs utterly impossible if the mains be interconnected at innumerable points with hundreds of fuses, the vagaries of which no man may know.

There can be little doubt that the most satisfactory arrangement by far, is to permanently connect the entire network, but in such a manner that it can rapidly be divided into several large areas, each supplied by its own feeders. All chance of breakdown must be guarded against by using nothing but the very best material, laid in the best possible manner, and a system of rigorously examining all joint boxes at stated periods. Further, it is of inestimable help in the time of trouble, if a small skeleton plan be kept of the entire network, with each section shown in a different colour, and each feeding and disconnecting point suitably marked. The insulation of each main should be periodically tested by earthing one of the others, and all appreciable faults removed as they occur. Nothing could more deliberately court disaster than to allow an uninsulated neutral to a three-wire system. When an earth develops on one main, there is a period of grace if the insulation of the others is fairly sound.

The Manchester engineers appear to have been somewhat censured for trying to keep up the pressure in spite of the fault; but the writer ventures to think that it is a proceeding which would have been followed in any other station in the country. To shut down the station because an abnormal load was observed would be sheer madness, to say nothing of the almost utter impossibility of locating the fault if this were done.

Finally, although, perhaps, Mr. Wordingham's remark about a column of smoke has been given a little more significance than he intended, it is certain that for faults on distributors, at any rate, instruments are of little practical use. Perhaps it is unwise and sometimes costly to drive unlimited horse-power down a faulty main, but a fairly large current suitably controlled by resistance *is* the best detector, and a pick and shovel, though, perhaps, unscientific, *are* the best instruments with which to locate a leak.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE EDDY CURRENT BRAKE FOR TESTING MOTORS.

By D. K. Morris, Ph.D., and G. A. Lister.

(*Abstract of Paper read at Birmingham on April 12th*, 1905.)

The testing of a motor for efficiency and suitable rating requires that the motor shall be subjected for short or long periods to a measured load of any desired amount. Steady maintenance and accurate measurement of the load are necessary, while the means of applying it should in no way affect the conditions under which the motor works.

The eddy current brake has many advantages over the band or rope methods of motor-testing. Among these are:—

(*a*) Sensitiveness combined with convenience of adjustment to exact balance.

(*b*) Uniformity of load, and exact constancy after final temperature conditions have been reached.

(*c*) Heat produced in energy-absorbing element not conducted to bearing.

(*d*) Absence of wear.

(*e*) Retarding torque only occurs.

The types of eddy brake on the market, however, have not been very widely used, mainly on account of the high initial cost, and the difficulty of applying them to various sizes and types of motors.

The authors, in designing a brake for the Electrical Laboratory of the University of Birmingham, decided to entirely dispense with separate bearings or frame. This brake is illustrated in fig. 1. It is intended to be mounted on the motor-shaft in place of the ordinary pulley. The fixed portion of the brake is carried by the revolving system, and though there is friction at the bushes, B and D, this small load is duly represented as torque on the brake-lever. A similar argument applies to the air friction.

Fig. 2 (p. 956) shows the brake mounted on the spindle of an electric motor, and indicates the manner in which the pressure on the motor-bearing may be adjusted. The brake is provided with a link suspension, so that an upward pull gives rise to no twisting moment. This suspension is attached to a spring balance, which can conveniently be carried by the hook of the crane or blocks serving the testing bed. By means of the lifting gear the pressure on the

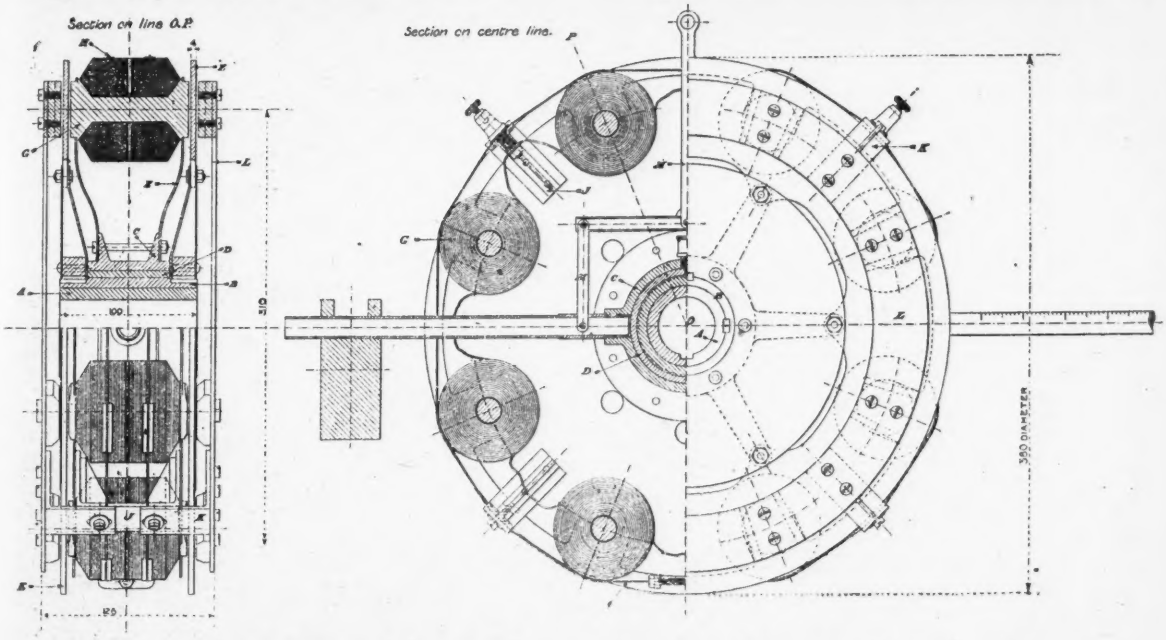


Fig. 1.—Eddy Current Brake for Testing Motors up to 5 b.h.p. at 1,000 r.p.m., or 7½ b.h.p. at 1,750 r.p.m., with Overload Capacity of 25 Per Cent.

bearing may be reduced to nothing, or it can be given any desired value. For ordinary testing the whole brake can very well be carried on the motor-spindle without suspension.

The construction described has therefore the following additional advantages, without in any way sacrificing those enumerated above:—

(*f*) Apparatus self-contained; no separate frame required; an advantage over all other practical types of brake.

(*g*) Brake is completely astatic.

(*h*) Air-friction error is practically eliminated.

(*i*) Pressure on motor-bearing during test may be adjusted to any desired amount, independent of the load.

The revolving disks, E, are made of high conductivity hard-rolled copper. They are supported by a thin steel plate and steel arms on the outer and inner sides respectively, each hub being keyed to the bush, B.

Between these disks is the casting, C, which is fitted with a gun-metal bush, D, bored to suit the bush, B. Into this casting are screwed two tubes, the shorter carrying the counterpoise, and the longer constituting the lever arm. This arm is marked with a scale of feet divided into tenths and hundredths of a foot, the maximum leverage being 3 ft. The brass plates, F, are bolted to the casting, C, and carry at their circumference the magnet coils, G. These coils, which are eight in number, are securely held in position by the steel wires, H. Each consists of a wrought-iron core wound with 1,400 turns of No. 20 S.C.C. copper wire. The resistance of each coil is 5·1 ohms when cold. There is a ventilating duct at the middle of the coil.

The aluminium castings, J, act as distance pieces, the two upper ones being fitted with insulated terminals. Secured to these castings by set-pins are the aluminium castings, K, which carry the external yoke-rings, L. A slotted hole in the castings, K, allows the length of the external air-gap to be adjusted. The length of the internal air-gap is fixed, and in consequence of the rigidity and smooth running can be kept short.

Steel bushes, A, are turned to suit the inside of bush B, into which they are keyed. They are bored out to various sizes to suit the spindles of the motors which have to be tested. The suspension links, M, are fitted to the graduated lever and to

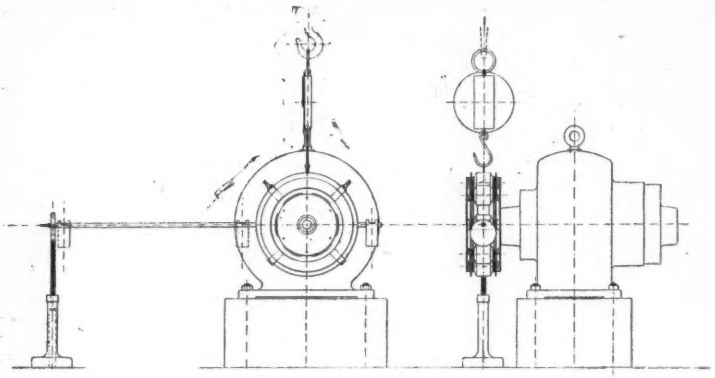


FIG. 2.—EDDY CURRENT BRAKE IN USE.

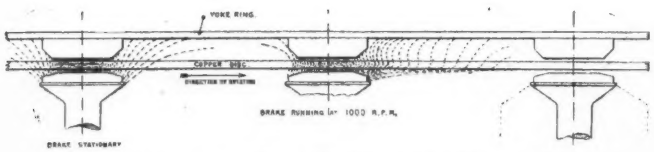


FIG. 3.—DIAGRAM SHOWING DISTRIBUTION OF FLUX IN AIR-GAP.

the counterpoise lever at equal distances from the centre. Accurately adjusted sliding weights of 2½ lb., 5 lb., 7½ lb. and 10 lb. are used.

After completion the brake was supported on a central knife-edge, and the counterpoise lever loaded until an accurate balance was obtained.

EXPERIMENTAL RESULTS OBTAINED.

1. A test to determine the result of reducing the number of magnets showed that the braking effect is practically proportional to the number of coils excited. The slight reduction observed was probably due to the increased length of the iron

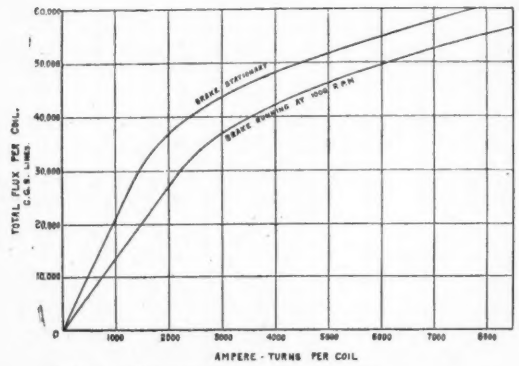


FIG. 4.—VARIATION OF FLUX WITH EXCITATION.

portion of the magnetic circuit. In other words, the braking effect depends only on the total flux cutting the copper, and is independent of the number of points at which it may be applied.

2. The removal of the external yoke-rings resulted in a reduction of the absorption capacity to about 50 per cent. of the normal for a given number of ampere-turns per coil.

3. The torque produced by bearing and air-friction alone (the magnets being unexcited) was found to be about 0·3 ft.-lb. at 500 r.p.m. This increased to 0·365 ft.-lb. at 1,250 r.p.m.

4. At moderate excitations, such as 4,000 ampere-turns per coil, the horse-power absorbed increases, except at first, nearly with the speed up to 1,000 r.p.m. Above this speed, however, there is a noticeable falling-off. At low excitations, such as 1,500 ampere-turns per coil, the falling-off occurs at about 600 r.p.m. This failure to reach proportionality is due to increased distortion of field at high speeds and consequent reduction of resultant flux. The flux which usefully cuts the copper may be taken as that which actually arrives at the yoke-ring. It will be seen from fig. 3 that the flux is shifted forward in the direction of rotation.

5. The brake was originally made with a plain yoke-ring without pole-pieces. The addition of pole-pieces 1 cm. deep, and having a radial length slightly less than the diameter of the magnet-core, somewhat increased the efficiency of the brake.

6. An attempt to prevent the flux from being dragged off the pole-pieces, and so prevent excessive lengthening of lines and consequent reduction of field strength, was made by winding the yoke-rings with additional magnetising coils situated between the pole-pieces. There were 16 coils, or two coils per magnet, each consisting of 25 turns of No. 18 D.C.C. copper wire. The effect was very noticeable.

The advantage, however, probably does not warrant the extra complication.

7. It was found that the braking effect for a given excitation is not perceptibly dependent upon the temperature of the copper disks. This shows that any decrease in the eddy currents due to increased resistance of path is counteracted by the consequently reduced distortion.

8. Experiments carried out with different lengths of air-gap emphasised the necessity of keeping this as small as possible. When absorbing 5 H.P. at 1,000 r.p.m., a reduction in the air-gap from 10 to 8 mm. reduced the current required by 15 per cent., thus resulting in a saving of power of rather more than 30 per cent.

9. Fig. 4 shows the variation of flux with excitation, both with brake stationary, and when running at 1,000 r.p.m. The thickness of the copper disk is 4 mm., and the length of air-gap between pole-tips approximately 9 mm. In each case the flux was measured at the centre of the magnetising coil.

10. Fig. 5 shows the variation of flux with speed, the excitation being constant at 1,400 ampere-turns per coil. The measurements were taken at the centre of the coil.

Thanks to the centre of gravity of the sliding weights being slightly below the centre line, the lever floats steadily after the magnetising current has been adjusted; this is obtained without material reduction in the sensitiveness. Trouble due to end-play of the shaft, which is extremely serious when the magnet system is carried on a separate frame, is entirely avoided in this brake.

The absorption capacity of the brake is limited by the heating of the magnetising coils, the disks being kept cool by the current of air over their surfaces. The brake was designed to absorb 5 H.P. at 1,000 r.p.m., and worked most efficiently at speeds of this order. Above 1,500 r.p.m., the falling-off of braking effect due to field distortion becomes noticeable, and below 500 r.p.m. the magnetising current required to brake 5 H.P. becomes too great for the coils.

The brake is found very convenient for testing motors for temperature rise and overload capacity. When temperatures have settled down, and the magnetising current is finally adjusted, the load remains perfectly constant.

Motors may be tested for starting torque by locking the revolving disks to the fixed portion of the brake.

The following notation is employed* :—

B_m	= maximum value of original or main flux ...	2,200 lines per cm.
B_r	= maximum value of resultant flux measured perpendicular to disk in the disk itself	1,370 „ „
p	= width of equivalent sine-functional flux in cm. measured along pole-centre line	3·8 cm.
β	= ratio of this width to the pole-pitch ($p \div \beta$ = pole-pitch)	0·31
b	= shift of resultant flux-wave from position of main flux	0·55 cm.
t	= thickness of disk in cm.	0·4 cm.
$2g$	= gap between pole-faces in cm.	0·9 cm.
ρ	= specific resistance of material of disk in C.G.S. units per cm.-cube (hot) ...	2,450
l	= radial length of average eddy current path (see fig. 6)	2·25 cm.
a	= resistance factor (should be from 1·2 to 1·5)	2
v	= speed of disk at effective pole-centre line in cm. per sec.	1,520 cm. per sec.
R	= speed of motor in r.p.m.	1,000 r.p.m.
D	= diameter of disk at pole centres in cm. ...	29 cm.

* The values given on the right are approximately correct for the brake described in the paper, when running at 1,000 r.p.m., and excited so that it absorbs 3·1 B.H.P.

The eddy current brake disk should have a thickness between the pole-pieces of

$$t = 0{\cdot}092\ \frac{a}{v}\ \text{cm.}$$

Any greater thickness will result in *decrease* of torque.

The theory developed by the authors leads to the following points of design:—

1. The rims of the brake disk should be thick compared with the thickness between opposing pole-faces, so that the currents may flow approximately radially (fig. 6).

2. When this condition is attained, the brake disk's thickness in millimetres should be about equal to the specific resistance of its material in C.G.S. units when heated—say about 2,000 for copper

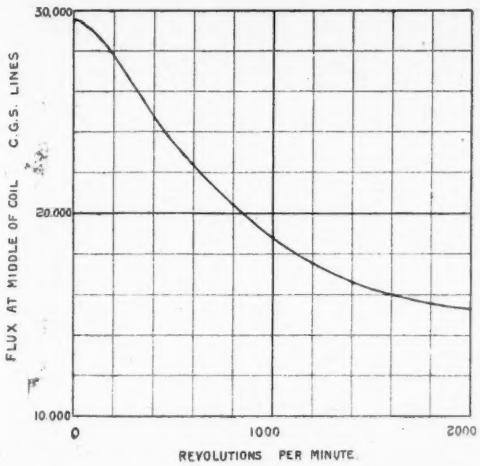


Fig. 5.

and 4,000 for aluminium—divided by the average linear velocity of the disk. For the brake described in the paper, when running at 1,000 r.p.m., or a mean linear velocity of 1,600 cm. per second, the best disk thickness is about 1·7 mm. if the disk rims are thickened, and probably about 3 mm. with a plain disk.

3. The pole-faces must be so designed that the point round which the lines of flux swing is but little within the pole-face. It is proposed to meet this condition by a series of radial cuts or narrow slots in the pole-face.

4. The radial lengths of the pole-faces should be as great as is convenient, the gap being made a shade less on the outside, so that the flux may not suffer radial displacement. And, generally, the polar area should be increased (making β nearly equal to unity) and the gap reduced as far as practicable in order to economise in

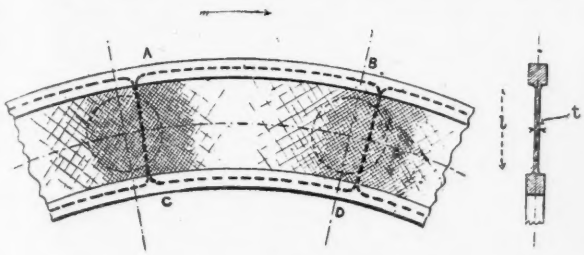


Fig. 6.

magnetising energy. A limit to this increase arises, however, if the magnet-cores are approaching saturation, on account of the diversion of the flux through the leakage-paths between the sides of the poles without crossing the disk at all. Approximate investigation seems to show that the best value of β is about 0·7 when the pole-faces have a width about equal to one-half the pole-pitch. If an allowance of 25 per cent. be made for the reduction in flux arising through leakage combined with core-saturation, the following expression—

$$3 \times 10^{-13}\ B_m^2\ D^2\ R\ l$$

would appear to represent roughly the maximum B.H.P. that can be absorbed in a given brake-disk running at the speed which is most advantageous for the thickness of brake-disk employed.

Putting $l = {\cdot}15\ D$, which represents as long a pole-face as is convenient, the expression becomes

$$4{\cdot}5 \times 10^{-14}\ B_m^2\ D^3\ R,$$

or, at 1,000 r.p.m.,

$$4{\cdot}5 \times 10^{-11}\ B_m^2\ D^3.$$

For a disk 15 in. in diameter over all, this becomes approximately

$$1{\cdot}35 \left(\frac{B_m}{1{,}000}\right)^2,$$

or 6·5 B.H.P per disk, with the flux-densities occurring in the brake described in the paper. This brake, with its two disks, should, therefore, be capable of absorbing 13 B.H.P. at 1,000 r.p.m. if the best design could be followed.

The authors have compared the theory with the results actually obtained, and have found throughout as substantial an agreement as can be looked for, considering that the theory applies properly only to a copper disk with thickened rim.

When it is remembered that this brake was designed before the theory as to correct proportions was worked out, and that by reducing thickness of disk, providing it with rims, widening the pole-faces, and slotting them, an increase of capacity amounting to over 100 per cent. should result, it will be seen that it may fairly be claimed for the eddy current brake that besides being quite the most convenient and compact for ordinary motor-testing, it will compare favourably, when correctly designed, with mechanical water-cooled brakes, in all respects except that of initial cost.

A brake embodying these improvements is being designed, and it is hoped that an early opportunity will be found of constructing it.

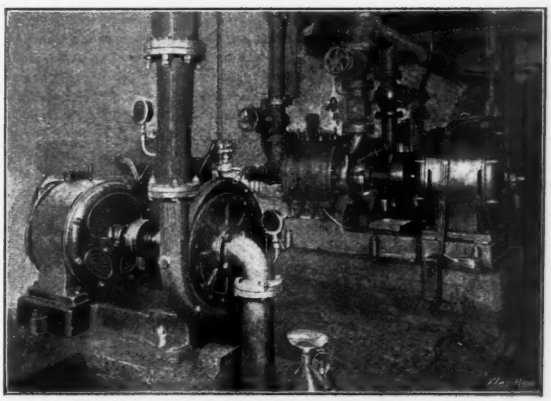
In conclusion, the authors wish to express their thanks to the Council of the University of Birmingham, through whose action they have been enabled to carry out this work.

ELECTRICALLY-DRIVEN HIGH-PRESSURE TURBINE PUMPS.

The Lewis Merthyr Consolidated Collieries in South Wales recently decided to install an electrically-driven high-lift turbine and auxiliary centrifugal pump at their Codcae pit, Hafod, near Pontypridd, in place of an already existing steam-driven pump, and gave the order for the work to the British Westinghouse Co.

The steam pump, which is now kept as a standby, is of a high-class type with differential valve gear and a condenser, and with steam and water cylinders 28 in. and 9½ in. in diameter respectively with a 4 ft. stroke. The full-speed duty is 25,000 gallons per hour against a head of 350 ft. Steam is brought down the shaft from the boilers on the surface, this entailing the usual wasteful condensation in the pipes, and occasioning the greatest inconvenience should a joint break. It may be mentioned that this steam pump occupies an area of 253 sq. ft. (39 ft. × 6 ft. 6 in.).

The accompanying illustration shows the new turbine pump, and also a small centrifugal pump, fixed in a heading close to the steam pump. These are driven by three-phase current taken from the mains of the South Wales Electrical Power Distribution Co., the current being transformed from 11,000 to 450 volts at a sub-station on the colliery premises. A three-core armoured cable conveys the low-pressure current down the shaft to a dividing box and switch-board, fitted with an oil-break circuit-breaker, fuses and indicating



Electrically-Driven Turbine and Centrifugal Pumps.

instruments. From this board the current passes to the oil-immersed auto-starters of the motors.

The larger pump is of the Worthington four-stage turbine pattern; the smaller is a 4-in. centrifugal pump of the same make, and both are direct-driven by Westinghouse "C.B." type three-phase induction motors, the larger of these being of 60 H.P. The function of the smaller pump is to supply an overhead tank for feeding the suction of the larger pump at starting, the supply being drawn from the various mine pumps.

The area covered by the old steam pump is 10½ times that required by the turbine pump (8 ft. × 3 ft.) and 7½ times that required by both electric pumps, the area covered by the centrifugal pump being 5 ft. 6 in. × 4 ft. 3 in.

The electrically-driven pumps possess a combined efficiency of nearly 70 per cent. when delivering 350 gallons per minute against a head of 342 ft., this being a very good figure.

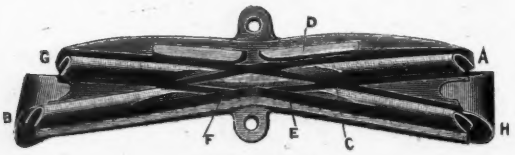
The type of motor shown in the figure is eminently suitable for driving both turbine and centrifugal pumps, in collieries as well as elsewhere, there being no brushes or other rubbing contacts. The

starting switches are wholly immersed in oil, and are fitted with gas-tight covers, so that they are perfectly safe for mine use. The attention required is practically nil, as the bearings of the motor and pump are self-oiling; and after they have been started the machines may be left entirely to themselves.

IMPROVED OVERHEAD CROSSING.

CROSSINGS and frogs are a necessary evil on overhead tramway work, and the erratic behaviour of the trolley at these points is often a most fruitful source of trouble. The smaller the angle of the crossing, the greater is the liability of the trolley to take the wrong wire. If, in addition, the trolley is side-running, and there is a certain amount of overhang on the trolley, this trouble is still further intensified. When a trolley is advancing through a crossing on to a trailing frog, there is considerably more liability of damage to the overhead gear than when it is travelling in the reverse direction. Should the trolley take the wrong wire under these conditions, the mechanical frog that it would meet on this wire presents a most effective trap, and serious damage to the trolley-head and overhead gear frequently ensues.

On the Burton-on-Trent Corporation tramways, narrow angle crossings of about 16° are used, with a certain amount of overhang on the trolley due to the cars not running centrally with the trolley wire round the junctions. Damage to trolleys and overhead gear has been of frequent occurrence, and, as a result, after numerous



NEW CROSSING.

experiments, with the object of bettering matters, an improved design of crossing has been brought out by the general manager, Mr. P. J. Pringle, which has been the means of reducing the troubles to a negligible amount.

The crossing is shown in the figure herewith. In designing it an attempt has been made to get in practice a continuous through rail, without any complicated gear or mechanism to affect it. If we imagine a trolley-wheel passing from A to B, there is always a possibility of its fouling the point C of the centre diamond, and being thrown off the crossing. That part of the crossing marked D acts as a guard rail to prevent this occurrence, and practically gives the equivalent of a continuous rail to the passage of the trolley wheel at this point. On the trolley wheel still further advancing, the hard phosphor bronze spring piece E is quite lightly sprung to one side, and then the flange of the trolley wheel meets the phosphor bronze spring piece F, guarding it from any possibility of taking the wrong wire. On the trolley advancing from G to H the same cycle of actions takes place.

All the crossings on the Burton-on-Trent Corporation tramways have been equipped with this pattern for the last six to eight months, and they have proved most effective. The spring pieces are made of considerable length, about 7 in., and are therefore quite flexible, so that the amount of wear on these due to the trolley wheel springing them open is exceedingly small, and they will have a considerable life. The replacement of them when necessary is arranged to be quite a simple matter.

We understand that the British Insulated and Helsby Cables, Ltd., have taken up the manufacture of this crossing.

THE EXHIBITION OF THE ELEKTRO-TECHNISCHER VEREIN IN BERLIN.

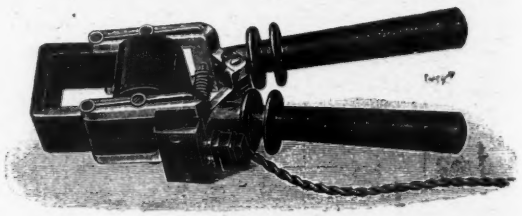
TOWARDS the end of last year the Elektrotechnischer Verein organised a comprehensive six days' exhibition of electrical apparatus, and an official account of the exhibits sent in is given in a recent number of the *Elektrotechnische Zeitschrift*. These exhibits were almost without exception of German manufacture, and appear to have included most of the novelties in lighting, switchboard, measuring, telegraphic and laboratory apparatus. Without attempting any detailed survey, it may be of interest to refer here to one or two of the exhibits.

A useful substitute for cotton or silk insulation on very fine wires was shown by the Allgemeine Elektricitäts Aktien-Gesellschaft, in the form of "acetate wire." The covering on this wire consists of numerous layers of cellulose-tetra-acetate deposited in a special machine. In spite of the fact that the covering is only about ·02 mm. (·0008 in.) thick, it possesses considerable mechanical strength, and is flexible and elastic. It is non-hygroscopic, unaffected by temperatures up to 150° C., and the above thickness (·02 mm.) withstands a breakdown pressure of 1,500 volts. The A.E.G. supply copper wire from ·07 mm. to ·17 mm. (·0027 to ·0067 in.) in diameter covered with this insulation, and it is found to reduce the space required for insulation by half, as compared with a double-silk covering, even showing a considerable saving over a single silk covering.

The Siemens-Schuckert Co.'s exhibit included a number of arc lamps burning special flame and other carbons, the most noticeable amongst which were those known as the "Edelweiss" carbons. These give a light which approaches daylight more closely than does that of the ordinary golden flame arc, and which allows surrounding objects to be seen in their natural colours.

Great interest was shown in a new interrupter (Ruhmer's patent) for use with induction coils. This consists of an electric arc arranged in parallel with a circuit containing capacity, and a self-induction (the primary of the induction coil) as in the Duddell singing arc, but distinguished from the latter by having a strong magnetic blow-out fitted under the arc which helps to set up a powerful high-frequency current in the parallel circuit. Frequencies up to 400,000 are obtainable with the instrument.

Another piece of apparatus for producing undamped high-frequency currents for long periods at a time, was shown by Messrs. Siemens & Halske. In this case a small direct or alternating-current



TESTING TRANSFORMER.

motor is used to drive an iron-toothed wheel, the teeth of which move in rapid succession past the poles of a horse-shoe electro-magnet. In this way the magnetic circuit of the latter is periodically altered, and high frequency currents (up to 10,000 periods per second) are induced in secondary windings placed on the electro-magnet. In order to prevent changes of load affecting the speed and periodicity, a small dynamo loaded on a resistance, is mounted on the same spindle as the motor and the toothed wheel.

Messrs. Hartmann & Braun showed a neat piece of apparatus (see fig.) for measuring currents in alternating current mains without interrupting the circuit. It consists of a small transformer, of which the main to be tested forms the primary. The transformer core is in two halves, which are normally kept together by a spring so as to form a closed iron circuit, but by pressing two handles together the iron circuit can be opened sufficiently to let it pass over the main. A voltmeter or a telephone connected to the small secondary coil then indicates whether the main is carrying current, and, if required, the amount of the current. The handles are highly insulated for use on H.T. mains. This instrument can also be conveniently used for determining the position of a fault in a cable carrying an alternating current. For this purpose it is not even necessary actually to clasp the cable with the transformer core, as merely opening the core and holding the opening near the cable will be quite sufficient to indicate whether current is passing and the point at which the current leaves the cable through the fault.

A novel form of oscillograph, especially suitable for lecture demonstrations, was shown by Messrs. Ruhmer. This consists of a special type of Geissler tube, and its action depends on the principle that the extent of the negative glow at the cathode of such a tube varies directly with the current strength. If a direct current is passed through the tube, a certain length of the cathode wire will become surrounded by the glow, whilst the anode will only glow slightly at the tip. When a high tension alternating current is passed both electrodes glow, but if the light is viewed in a synchronously rotating mirror, the successive phases (in time) of the current appear side by side in space, and the boundary line of the mirror image of the glow gives the shape of the alternating current curve directly.

THE CANADIAN REPORT UPON THE ELECTRO-METALLURGY OF IRON AND STEEL.

(*Concluded from page* 876.)

METALLURGICAL DETAILS.

Mr. Harbord writes of the Kjellin furnace that it is admirably, but only, adapted for the manufacture of the highest class of steel from pure materials; it would require considerable modifications before it could be used for the preparation of mild steel to compete with the Siemens furnace. The steel itself, whether high or low carbon, is of the highest quality, there being practically no segregation in

the ingots, while its mechanical and welding properties are equal to the best. It takes longer to produce soft steel by the Kjellin process than high carbon steel; but in Héroult's process the reverse is the case. Mr. Harbord considers the Héroult furnace to be extremely well designed, and thinks furnaces up to 10 or possibly 15 tons capacity, but not larger, should give satisfactory results, although they could hardly hold their own against 40 or 50-ton gas-fired furnaces, or against 100 or 200-ton Talbot furnaces. Analyses of drillings from different parts of the Héroult ingots show the steel to be remarkably uniform in composition. Tensile tests of Kjellin and Héroult steels are all very satisfactory, giving figures such as should be expected from high-class steels containing different percentages of carbon. The maximum stress increases with the carbon to about 0·9 per cent., with a corresponding decrease in elongation and reduction of area. Photomicrographs are quite normal, except in the low carbon steels, where the ferrite areas are unusually soft. Speaking generally, "the three processes of steel manufacture which the Commission has had an opportunity of investigating are all capable of producing equally good steel, and the selection of one or the other would depend upon local conditions." The Kjellin process is the nearest approach to the crucible process, and, being conducted in a closed hearth, there is no possibility of impurity being introduced into the metal from the electrodes. Some purification can be effected during melting, but otherwise it is limited to the treatment of pure raw materials. On the other hand, furnaces of the resistance type with electrodes can treat phosphoric scrap and pig-iron in the same way as a gas-fired Siemens furnace. The neutral atmosphere, and the intense heat, allow very basic slags to be used, and the mechanical arrangements enable a pure non-oxidising slag to be present at the end of the operation, so that the last traces of phosphorus can be removed.

Mr. Harbord includes a report from Mr. H. F. Donaldson, chief superintendent of the Ordnance Factories, at Woolwich, where tools of electrical steel forged to the regulation shapes, were tested against others made from the normal Woolwich crucible steel known as grade "A," and against Mushet's steel. It was only claimed for the electrical steels that they should be equal to the "A" material, and they were tested against the Mushet steel merely to see if they were superior to the "A" grade. Generally speaking there was little difference between the electrical samples and the "A" tools. They were inferior to the Mushet steel which was well within its capacity at a cutting speed of 19 ft. per second; but at the ordinary contract speed of about 14 ft., they were "good of their class." Mr. Harbord's opinions about the reduction of iron ore by electric smelting may be taken as summed up in his general conclusions, previously mentioned.

The Ruthenburg Process.

This is a process for passing magnetite through crushing rollers, then through magnetic separators to eliminate non-magnetic constituents, next, after admixture with a small excess of carbon, through a magnetic field, where it should be partially reduced and deprived of its magnetism, and then into a cooling pit, where it is expected to agglomerate, and to be still further reduced. Finally, it is to be melted in a cupola, and cast into ingots, or transferred to an open hearth furnace and converted into steel. The Commission's investigations show "that the reduction of the magnetite, either in the gap of the furnace or in the soaking pit below, is insignificant." "The process is an entire failure as one for either agglomerating and fritting the ore, or for any useful reduction." The fact that magnetite loses its magnetism before incipient fusion takes place, precludes the hope that modifications of the process may render it commercially useful for agglomerating finely-divided ore as a substitute for briquetting.

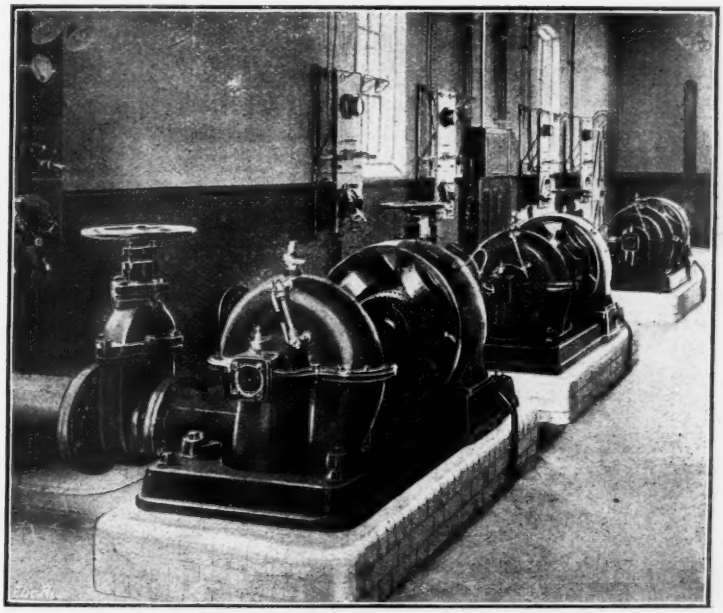
The last 200 pages of the report are taken up by the translations of the monographs we have already mentioned by their titles.

ELECTRICALLY-DRIVEN SEWAGE PUMPS.

We illustrate herewith part of an installation of motor-driven centrifugal pumps which has recently been supplied by Messrs. W. H. Allen, Son & Co., Ltd., of Bedford, to the order of the Corporation of Canterbury, for service on its sewage disposal works.

The complete contract includes four motor-driven sewage pumps of Messrs. Allen's Conqueror type, having suction and discharge branches each 10 in. diameter; each pump is capable of delivering 100,000 gallons of sewage per hour against a head of 20 ft. when running at a speed of 535 r.p.m., and absorbing approximately 20 B.H.P.

In addition to these four pumps, Messrs. Allen have also installed two storm-water motor-driven centrifugal pumps, each having suction and discharge branches of 14 in. diameter, and each capable of delivering 250,000 gallons of water per hour against a maximum head of 20 ft. when running at a speed of 425 r.p.m., and absorbing approximately 37 B.H.P. The centrifugal pumps are of Messrs. Allen's standard pattern, the casings being cast in two halves, and bolted together along a horizontal diameter. The impellers are likewise of cast-iron, and are securely keyed to a steel spindle. The bearings are of cast-iron lined with white metal, and lubrication is effected by "Stauffer" spring grease cups.



Allen Pumping Plant at Canterbury Sewage Works.

The motors for driving both sewage and storm pumps are mounted on the same base-plate as the centrifugal pump in each case, and are of the company's standard four-pole shunt-wound type, designed for the speeds named when supplied with continuous current at about 450 volts. The pumps are provided with the usual suction foot-valves, delivery valves, charging valves and water gauges to show the height of water in the pump when charging. Each motor is provided with a separate switch panel mounted on the wall, equipped with a patent starter with no-voltage and overload automatic releases, and independent shunt regulator interlocked with the starting switch in such a manner that the field resistance is all cut out at starting; also each switch panel is provided with a suitable ammeter, a double-pole switch, and two lamp-brackets, the lamps being coupled across the terminals of the double-pole switch in such a manner that they are lighted only when the switch is closed. A main fuseboard has also been installed.

The illustration shows the arrangements of the four sewage pumps and motors, together with their switch panels.

Boston Lighting.—The Lighting Committee of the T.C. has recommended that Messrs. J. & S. Enright should be instructed to prepare an E.L. scheme for the borough, at a fee of £210 for their services.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

2,310A. "Improvements in electric switches." W. Fairweather. (The National Electric Co., United States.) (Date applied for under Patents Rule 9, February 6th, 1905.) May 22nd. (Complete.)

10,629. "A new or improved system of apparatus for automatically releasing electric telegraphs." E. Ducretet. May 22nd. (Complete.)

10,639. "Improvements in apparatus for use in regulating the load on direct-current electric generators." E. S. W. Moore and W. G. Strang. May 22nd.

10,644. "Improvements in or connected with automatic electro-magnetic sanding gear, for use on electric railway and tramway vehicles," M. Cummins. May 22nd.

10,647. "Improvements in telephones." P. A. Vaile. May 22nd.

10,653. "Improvements in vapour-electric apparatus." P. H. Thomas. (Date applied for under Patents Act, 1901, May 25th, 1904, being date of application in United States.) May 22nd. (Complete.)

10,669. "Improvements in combined electric switches and fuses." Callender's Cable and Construction Co., Ltd., and J. C. A. Ward. May 22nd. (Complete.)

10,694. "New or improved means for neutralising static electricity." W. H. Chapman. May 22nd. (Complete.)

10,695. "New or improved apparatus for neutralising static electricity." W. H. Chapman. May 22nd. (Complete.)

10,696. "New or improved apparatus for neutralising static electricity." W. H. Chapman. May 22nd. (Complete.)

10,707. "Improvements relating to switching devices for use in electric flash advertising." L. K. Job. May 22nd.

10,708. "Improvements in receivers for wireless telegraphy." W. P. Thompson. (Ges. für Drahtlose Telegraphie m.b.H., Germany.) May 22nd. (Complete.)

10,709. "Improvements in receiver connections for wireless telegraphy." W. P. Thompson. (Ges. für Drahtlose Telegraphie m.b.H., Germany.) May 22nd. (Complete.)

10,710. "Improvements in transmitters for wireless telegraphy." W. P. Thompson. (Ges. für Drahtlose Telegraphie m.b.H., Germany.) May 22nd. (Complete.)

10,728. "Improvements in suspension devices for electric arc lamps." A. Wunderlich and G. A. Hughes, trading as the London Electric Firm. May 23rd.

10,793. "Improvements in electrical signalling apparatus." L. B. Woodworth. May 23rd.

10,794. "Improvements in electric signalling apparatus." L. B. Woodworth. May 23rd.

10,816. "Improvements in and relating to clutch mechanism for detachably connecting an arc lamp, or other appliance or apparatus, to a post, pillar, or other high-up support at a point out of reach." Veritys, Ltd., and F. S. Worsley. May 24th.

10,818. "Improvements relating to self-contained travelling cranes with oil, gas and electric motors and dynamos." W. G. Potter. May 24th.

10,819. "Improvements in and relating to apparatus for determining the presence and nature of electric currents in a circuit and for ascertaining the voltage of such currents." F. H. Varley. May 24th.

10,828. "An improved overhead travelling hoist or 'jenny' for electric or other power." A. C. Peake and J. R Crosthwaite. May 24th. (Complete.)

10,820. "Improvements in apparatus for starting and for regulating the speed of compensated single-phase electric motors." E. Arnold and J. Lassen. (Date applied for under Patents Act, 1901, May 24th, 1904, being date of application in Germany.) May 24th. (Complete.)

10,887. "Improvements relating to magneto-ignition devices of internal combustion engines." S. D. Holden and F. V. Russell. May 24th.

10,888. "Improvements in or relating to primary batteries." K. C. White and J. Cowley. May 24th.

10,892. "Improvements in systems of electric motor control and apparatus therefor." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 24th.

10,893. "Improvements in and relating to systems of electric motor control and in apparatus therefor." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 24th.

10,895. "Improvements in and relating to electric motor control systems and in apparatus therefor." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 24th.

10,896. "Improvements in and relating to systems of electric motor control and in apparatus therefor," The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 24th.

10,897. "Improvements in and relating to dynamo-electric machines." (The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 24th.

10,910. "Improvements in or relating to electrical switches." W. H. Isherwood. May 24th.

10,949. "Improvements in insulation for commutators." M. Meirowsky. May 25th.

10,959. "Improvements relating to electrical measuring instruments." H. Hertzberg, W. P. Snyder, J. H. Griffin and H. I. Bernhard. May 25th. (Complete.)

10,970. "Improvements in or connected with insulated electric wires." W. Osmond. May 25th.

10,973. "Improvements in terminals for electrical apparatus." H. W. Smith. May 25th.

11,012. "Improvements in terminal clips for electric cables." M. A. Codd. May 26th.

11,036. "Improvements in alternating-current measuring instruments." F. Conrad and W. M. Bradshaw. (Date applied for under Patents Act, 1901, May 27th, 1904, being date of application in the United States.) May 26th. (Complete.)

11,040. "Improvements in electric batteries." D. Fuller. May 26th.

11,056. "Improvements in and connected with electric accumulator plates." H. Fairbrother. May 26th.

11,057. "Improved means applicable for use in transmitting and receiving communications by wireless telegraphy." J. G. Balsillie. May 26th.

11,061. "Improvements in brush-holders for dynamo-electric machines and the like." C. W. Speirs and J. Frith. May 26th.

11,074. "Improvements in and relating to the regulation of the voltage of alternating-current systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 26th.

11,075. "Improvements in electric heaters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) May 26th.

11,076. "Improvements in brush-holders for dynamos and motors." H. F. Joel, sen. May 26th.

11,082. "An improved means of speed control and voltage regulation for electric motors and dynamos." W. A. Stevens. May 27th.

11,142. "Improvements in insulating tapes." Callender's Cable and Construction Co., Ltd., and G. Barnard. May 27th.

11,146. "Improvements in the manufacture of electrical resistances." The Electric Equipment and Securities, Ltd., and C. Ruzicka. May 27th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

Electric Motors. A. L. Cushman. 8,018. April 7th.

Fire Alarms. F. R. C. Joice. 8,262. April 9th.

Magneto-Electric Machines. G. W. Somerville, O. Hicks and Howard and Bullough. 8,436. April 14th.

Tramway Vehicles. A. James and F. Bryan. 8,550. April 15th.

Energy Meters. E. A. Carolan. (General Electric Co., U.S.A.) 8,670. April 16th.

Electroplating. P. Hubert. 8,679. April 16th.

Wireless Telegraphy. W. H. Wheatley. (E. C. Lewis and C. Armitage.) 8,774. April 17th.

Hair-curling Appliances. M. Shepherd. 8,971. April 21st.

Telegraphs. S. G. Brown. 9,231. April 23rd.

Galvanic Batteries. J. von der Poppenburg. 9,350. April 25th.

Wireless Transmission of Energy. A. Artom. 9,408. April 25th.

Electroplating. B. J. Round and A. Round (trading as Round & Sons). 9,531. April 28th.

Switches. W. W. Lackie, W. T. Calderwood and W. H. D. MacEwen. 9,535. April 28th.

Switches. H. W. Harris. 9,552. April 28th.

Arc Lamps. H. Edmonds, W. Seymanns and W. Keim. 9,716. April 29th.

Lamps: Incandescent Electric. A. W. Hill and Sir H. Maxim Electrical and Engineering Co. 9,821. April 30th.

Telephone Systems. B. Brander. 9,951. May 2nd.

Sparking Preventing. V. A. Fynn. 9,990. May 2nd.

Arc Lamps. H. J. Norballe and T. G. Foulkes. 9,998. May 2nd.

Clocks, Electric. P. M. Justice. (J. S. Morse.) 10,071. May 4th.

Switches. E. N. Bray, F. R. Markham, F. E. Reiss & Bray, Markham & Reiss. 10,207. May 5th.

Switches and Cut-outs. J. Booker. 10,218. May 5th.

Telephone Systems. H. H. Lake. (A. K. Andriano, U.S.A.) 10,236. May 5th.

Cables. G. G. M. Hardingham. (Felten & Guilleaume, Carlswerke, Aktien Gesellschaft, Germany.) 10,295. May 6th.

Switches and Cut-outs. B. Thomas and E. Thomas. 10,342. May 7th.

Incandescent Electric Lamps. Evered & Co. and S. Evered. 10,395. May 7th.

Switches. H. Oppenheimer. (Aketin Gesellschaft, Mix & Genest.) 10,594. May 9th.

Switches. G. W. Mascord. 10,652. May 11th.

Cables. S. G. Brown. 10,667. May 11th.

Motors. R. Zeigenberg. 10,698. May 11th.

Measuring Electricity. R. Ziegenberg. 10,697. May 11th.

Galvanic Batteries. W. Heym. 10,728. May 11th.

Miners' Electric Lamps. E. Edwards. (O. Mallet and A. Parent.) 10,814. May 12th.

Galvanic Batteries. R. Callandri. 11,145. May 15th.

Motors. L. Schüller and Ferranti, Ltd. 11,299. May 18th.

Switches. G. Mamy. 11,525. May 20th.

Telegraphs. J. Timm. 11,515. May 20th.

Railways, Electric. W. F. Smith. 11,585. May 21st.

Lamps, Electric. E. A. Carolan. (General Electric Co., U.S.A.) 11,607 May 21st.

1904.

"Cluster's" for Incandescent Electric Lamps. J. H. Dale. 6,873. March 22nd.

Electrical Ignition Apparatus. A. Eckstein and H. J. Coates. 6,878. March 22nd.

Electrodes for Arc Lights. F. J. Gerard and L. Fiedler. 6,972. March 22nd.

Production of Metal of the Alkali Group by Electrolysis. E. A. Ashcroft. 7,056. March 23rd.

Electro-Depositing Apparatus. The Leeds Copper Works, Ltd., and J. C. Joblin. 7,061. March 23rd.

Magneto-Electric Machines. F. R. Simms. 7,217. March 25th.

Electrical Switches. V. Bornand. 7,267. March 26th.

Administering Electric Light Baths. G. E. Gaiffe. 7,304. March 26th.

Electroliers, Gas and Oil Pendants and the like. E. W. Sanders. 7,627. March 31st.

Bayonet Joint for Electric Lamps and other Articles. L. Barlow. 8,192. April 9th.

Electric Furnace for Converting Pig-Iron into Steel. G. Gin. (Date claimed for patent under Patents Act, 1901, June 4th, 1903, being date of application in Belgium.) 8,216. April 9th.

Telephones for Use in Dictating Correspondence, for Exchange Call-Room, for Personal Use, and for Other Like Uses. S. J. Port. 8,262. April 11th.

Spark Plugs. E. van Morse. 8,332. April 11th.

Storage Batteries or Accumulators. W. Fairweather. (Vesta Storage Battery Co., U.S.) 8,365. April 12th.

Printing Telegraph Receivers. F. J. Swift. 8,540. April 13th.

Commutators for Dynamo-Electric Machines. F. W. Young. (Date claimed for patent under Patents, Act, 1901, May 22nd, 1903, being date of application in United States.) 8,608. April 14th.

Transmission of Electrical Impulses. J. S. Richmond. 8,612. April 14th.

Printing Telegraph Receivers. J. D. White. 8,657. April 15th.

Electric Switches. H. J. Gore. 8,714. April 15th.

Electric Circuit Cut-Outs or Switches. W. P. Thompson. (C. Johnston and C. Johnston, U.S.) 8,715. April 15th.

Trolley Pulleys of Electric Tramcars. G. A. Binns. 8,745. April 15th.

Incandescent Electric Lamp Fittings. S. Loti and R. Lanzko. 8,819. April 16th.

Safety Appliances for Electric Circuits. Siemens Bros. & Co., Ltd. (Siemens & Halske Aktiengesellschaft, Germany.) 8,826. April 16th.

Arrangement of Electrically-Driven Fluid Compressing Pumps, and Pressure Controlled Electric Switches therefor. B. Hyde. 8,909. April 18th.

Line Selectors of Intercommunication Telephone Apparatus. F. Wallock. 8,912. April 18th. (Date claimed for patent under Patents Act, 1901, September 25th, 1903, being date of application in Germany.)

Section Insulators for Overhead Trolley Wires. Siemens Bros. & Co., Ltd., J. F. Simpson and H. C. Wheat. 8,965. April 19th.

Telephone Systems. T. W. Gleeson and R. Hamilton. (Date claimed for patent under Patents Act, 1901, May 1st, 1903, being date of application in United States.) 8,992. April 19th.

Protecting the Live Parts of Electric Switches or the like. W. McDevitt. 8,999. April 19th.